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EFFECTS OF COGNITIVE SET AND THE VARIETY OF RELEVANT
EXPERIENCE ON CONCEPT FORMATION IN CHILDREN.

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THIS EFFORT WAS AN INVESTIGATION OF THE PROCESSES WHICH
OCCUR WHEN CHILDREN ARE SET TO FORM CONCEPTS AND,
ALTERNATELY, THOSE WHICH OCCUR WHEN CHILDREN ARE EXPOSED TO
MATERIAL AND NO DELIBERATE EFFORT IS MADE TOWARD CONCEPT
FORMATION. THE EXPERIMENTAL PLAN WAS AN INDEPENDENT GROUP
DESIGN IN WHICH THE MAJOR VARIABLES WERE INTENTIONALITY OF
SET (INTENTIONAL OR UNINTENTIONAL) AND VARIETY OF INSTANCES
(SMALL OR LARGE). EXPERIMENTS WERE CONDUCTED WITH SAMPLES OF
KINDERGARTEN CHILDREN AND CHILDREN IN THE FOURTH AND FIFTH
GRADES. A LARGE VARIETY OF INSTANCES WERE USUALLY FOUND TO BE
MORE EFFECTIVE IN PROMOTING VERBAL CONCEPT ACQUISITION THAN A
SMALL VARIETY. IN ADDITION, THE GENERAL CONCLUSION WAS THAT
THE INTENTIONAL INSTRUCTIONAL SET WAS MORE USEFUL IN
FOSTERING VERBAL ACQUISITION AND RECALL FOR CHILDREN IN BOTH
AGE GROUPS THAN WAS THE INCIDENTAL SET. THERE WAS NO EVIDENCE
OF RELIABLE INTERACTION BETWEEN VARIETY AND SET. (JH)

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Effects of Cognitive Set and the Variety of Relevant
Experience on Concept Formation in Children

Cooperative Research Project No. 1459

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University of California, Berkeley

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Preface

As those who have worked with children know, it is often interesting to ask children how they arrived at the solution of a problem. Although it is sometimes revealing to study their introspections, this method does not permit the study of the mental processes during concept formation of all children in the same way. Consequently, this project is an attempt to infer mental processes from observable behavior, and more specifically, from the effects of experimentally manipulated treatments.

The difficulties of testing children in intact classrooms can be imagined by all those who have been in a classroom on the day a new teacher or a "substitute" arrives. Yet, despite the difficulties, we did obtain, on the whole, fine cooperation from the subjects of our experiments. In the two cases where it was not possible to use the data collected because of difficulties of administration or errors made during this administration, the details are not reported in the body of this report. On the whole, we must acknowledge the cooperation of the pupils of the Berkeley and San Leandro Public Schools as the most important contribution to this project. This cooperation was, in turn, brought about by the administrative efforts of C. H. Wennerberg, Superintendent of Schools, Berkeley Unified School District and Mr. Alex Smith, Superintendent, San Leandro Unified School District, and the truly helpful contributions of the following principals: Robert Muscio, Ted Blitz, Harriett Wood, Elmer Venter, and Orville Sipe. It is with real gratitude that we thank the participating teachers who cooperated with us in many ways, sometimes by helping to proctor tests, often by instilling the class with an attitude of respect, frequently by giving up their own time to make arrangements with us and to provide us with information.

The complete listing of authors of this report is not given on the title page. It includes the many research assistants and statistical clerks who assisted in collecting the data and spent many hours carefully processing data and making tables. We gratefully acknowledge the contribution of Jack Coh, Lynn Diamond, Carolyn Latham Clough, Illene Katz, Anita Spring, Karen Tankersley, Phyllis Marx, and Ruth O'Neal. In addition, Mabel Gardner, Virginia Cunningham, and Andree Workman have accomplished the difficult typing jobs involved.

The Computer Center of the University of California has provided the services of the 7090 for the analysis of the data.

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I. Introduction: Processes of Thinking in Children.

The Problem and Related Research

The present study concerns the processes of thinking which characterize children of different ages and backgrounds. Two processes have been inferred by various investigators and were studied in this project. The first process which has been called deductive reasoning involves Active Search (Heidbreder, 1924), systematic testing of hypotheses, and moreover, occurs during an intentional learning set. It has been described by Woodworth (1939), Heidbreder (1924) and others. Postman (1950) made an attempt to formulate the hypothesis testing process in a more rigorous manner and Podell (1958) extended this formulation and tested it experimentally. Bruner, et al (1956) have also contributed theoretical and empirical explication. The second process is an intuitive one by which concepts are arrived at on the basis of associations to the presented stimuli. The process may correspond to the behavior described by Heidbreder (1924) as Spectator Behavior, and would be most prominent under an incidental set when no deliberate strategies of learning would be in process. However, it is believed that this intuitive process should operate at all times in all persons but would merely be obscured by other, more strategy-controlled processes.

At the outset of the present study it was hypothesized that the intuitive processes must be operative in children of all ages, but the deductive process must originate in children older than six. This hypothesis was based primarily upon the work of Piaget which suggests the existence of these processes and the emergence of deductive thought in children over 7. Inhelder and Piaget (1958) in describing the achievements of children in the logical solution of problems have posed a strong contrast between the intuitive thinking in children aged four to seven and the operational thinking of young adolescents. Similarly, Vinacke (1950) has proposed contrasting processes of concept formation in children of increasing age. Osler and Trautman (1961) have found supporting evidence for this hypothesis.

Hypotheses and the Rationale Behind Them

A. Concerning the Effect of Instructional Set

The main hypothesis, discussed above, concerning the emergence of deductive reasoning implies that the effect of certain instructional sets should vary among children of diverse ages. When a set is induced to learn deliberately in a situation in which deductive reasoning would readily be employed, a pre-school or Kindergarten child would be expected to behave in the same fashion as when he is not instructed to learn intentionally. However, the older child would be expected to learn more effectively when given the intentional set for he would set about reasoning deductively in this case while he would not do so in the presence of an incidental set. Consequently, it was hypothesized that the differences in learning efficiency under an intentional and incidental set would be greater for the older child than for the younger one.

One problem with this hypothesis is that the older child may also act different under the aesthetic set.

Rasmussen and Archer (1961), also using college students, compared the relative effectiveness of concept formation following two pretraining conditions. In the one case, the Ss were familiarized with the materials to be used in the concept formation experiment by having them rate the instances for pleasantness (Aesthetic Set). In the other case, the Ss were instructed to learn one associate of two nonsense names to each of the instances (Learning Set). Surprisingly, no difference was found between the concept formation of the two groups. If they had used different sets during the concept acquisition phase, we would expect that they would have found contrasting results, as did Podell (1958). Rasmussen and Archer explain their results on the basis that the Ss in the aesthetic set were more analytical than those under the learning set. Further, they tended to verbalize the dimensions in each of the stimuli in order to make their pleasantness judgments.

B. Concerning the Relationship between Instructional Set and Variety

In a logical analysis of the intuitive and deductive thinking processes, it was discovered that the number of different instances used in forming concepts might have different consequences

for the two processes (Podell, 1958). When many different instances (large variety) are presented under the intuitive thinking process, concept formation is less efficient than when a small variety of different instances is included. This comes about largely because of the assumption for which some evidence exists, that concept formation and memory are inextricably linked in this type of thinking (Podell, 1962). That which is remembered best tends to be seen as basic to the concept of the class-to-be-learned and the small variety of different instances should promote better recall. However, the effect of variety on the deductive process contrasts with this outcome. The larger the variety the more readily the S can reject false hypotheses since a subsequent instance would tend to be different from the one on which he formulated that hypothesis. However, the large variety may also involve the possible formulation of more different hypotheses than the small variety. This comes about by way of the fact that each instance contains both relevant and irrelevant aspects and the total number of irrelevant aspect is greater for the large variety than for the small variety condition. However, if the S is also employing intuitive thinking, he should not be more likely to test hypotheses referring to infrequently occurring aspects than to test hypothesis referring to frequently recurring aspects. Consequently, the probability of testing a hypothesis referring to an irrelevant aspect should be considerably greater under the small variety condition where particular irrelevant aspects occur with greater frequency than do particular irrelevant aspects in a large variety condition.

It was hypothesized in section A that for older children deductive reasoning should be more frequently employed, and when it does occur it should be more efficient than for younger children. Consequently, the interaction of variety and set which is discussed above should be more prominent for the older child than for the younger one.

C. Concerning the Effect of Variety

In an earlier study (Podell, 1958) on the effect of variety as a function of set, an aesthetic set was used to explicate the basic intuitive process, and an intentional learning set was used to explicate the deductive reasoning process. Confirmation for the contrasting effects of variety under the two conditions of instructional set, discussed under B above, were obtained; i.e., small variety led to more efficient concept formation for the intentional set. This study was conducted with college students who would be expected to have a strong tendency to use deductive reasoning when it appeared appropriate. For very young children, for whom deductive reasoning may be relatively inefficient or relatively low in the hierarchy, it is hypothesized that small variety would facilitate concept learning regardless of instructional set. For older children there would be no overall hypothesis concerning the effect of variety; but rather, the effect of variety is hypothesized to vary with the instructional set and with the efficiency of a deductive reasoning strategy in a particular situation.

A number of investigators have studied the effect of varying the variety of instances on varying aspects of human concept formation. Morrisett and Hovland (1959) found that initial acquisition of a concept seems to be better under single problem learning. However, immediate transfer is clearly superior for a medium variety of instances, and a very large variety is least efficient both for acquisition and transfer. Similarly, Adams (1954) found that training on repeated presentations of the same problem (very small variety) led to greater and earlier proficiency in solving the problem than multiple problem training. In contrast to the results mentioned above (Morrisett and Hovland, 1959) he found that the small variety condition facilitated transfer to new problems also. However, careful scrutiny of his data suggests that Ss under multiple problem training never learned the entire concept, and thus could not have transferred a response they never acquired. In a very convincing study, Callantine and Warren (1955) found that for initial acquisition small variety promoted quicker acquisition than large variety, but for transfer the opposite results obtained. It seems clear that transfer requires acquisition of the concept at the outset, but given this, a large variety is more conducive to generalization to new situations than a small variety. However, the question of which variety type enhances acquisition is still quite controversial. The effect of variety which is discussed theoretically and quite abstractly in the earlier paragraphs of this section may well be modified in the light of the particular nature of the task and kinds of materials involved.

D. Concerning the Tasks Employed

The Verbal Acquisition Task involves the acquisition of verbal concepts from the contexts in which they occur. The particular task which is used in the present study is based on materials used by Werner and Kaplan (1952) which they called the Word Context Test. They presented several series of sentences each containing a nonsense word. The nonsense word replaces a specific verbal concept the meaning of which is to be acquired by the S. For example, the following sentences were among those from which the concept gather was to be abstracted:

All the children will lidber at Mary's party.

The police did not allow people to lidber on the street.

This test involves a variation of the Cloze technique which was originally used to determine the readability of text (Taylor, 1953). Words were deleted from text and Ss were tested for their comprehension of it. The more redundant the test, the more comprehensible it is in the absence of a given number of words. In the present use of the technique, an attempt is made to study the effect of the variety of the context on the acquisition of the meaning of the missing word.

The Perceptual Recall Task involves the detection of repeated features of presented instances, and their recall. Concept formation is thought to be a complex task which involves detection of repeated similarities, their recall, and their relationships to one another. This task deals with only two of the three parts of concept formation and does not single them out. It involves the presentation of successive pages containing colored forms in various positions. The Ss' task is to recall the color, size, shape, and position of the forms which recur.

II. Verbal Acquisition Experiments

Verbal Acquisition Experiment 1

Subjects and Method

Characteristics of the Ss

The experimental procedures of the easy task were administered to eight Kindergarten and eight 4th and 5th grade classes. The samples used in the data analysis involved only 112 Ss of each grade level. The experimental procedures of the difficult task were administered to four of the above 4th and 5th grade classes and to four additional 4th and 5th grades. Ten of the older classes and all of the Kindergarten classes were from public schools in Berkeley, California. Two of the older classes were from a public school in San Leandro, California.

The C.A. of the Kindergarten Ss ranged from 5'4" to 7'3" and that of the older Ss in both samples from 8'7" to 12'7". The M.A.s of the sixteen classes to which the easy task was administered, was determined by the SRA Mental Abilities scale for ages 5 to 7, and 7 to 11. The intelligence tests were administered in intact classes with three assistants usually present in the Kindergarten classes. Mental Ages were estimated from part of the test in a few cases. The SRA was always administered prior to the Verbal Acquisition experiment. Available IQs, usually Henmon-Nelson IQs, were used to estimate M.A. for the eight groups to which the difficult task was administered. The correlation between the available IQs and the SRA IQs administered by us was found to be +.74. The correlation was based on forty cases; ten randomly selected from four 4th and 5th grade classes.

The M.A.s for the Kindergarten sample ranged from 5'6" to 6'2", the M.A.s of the 4th and 5th grade sample for the easy task ranged from 8'7" to 13'8", and the M.A.s for the 4th and 5th grade sample for the difficult task ranged from 9'9" to 13'8". The M.A. means and ranges for each of the cells of the experimental design appears in Appendix B. An attempt was made to match the eight Kindergarten groups and the two sets of eight older groups for mental age means and variance.

Materials

Four concepts were selected to be acquired by children from their use in sentences. The two easy concepts were the nouns newspaper and train, and the two difficult concepts were the verbs gather and increase. Two pilot studies and the discussion by Werner and Kaplan (1951) led to the assumption that nouns, especially concrete nouns, would be easier than verbs.

Two paragraphs were composed for each of the two easy concepts, one for the large variety condition and one for the small variety condition. The concept, for which a nonsense word was supplied, appeared the same number of times in both passages. The passages were also of approximately the same length. However, the small variety passage contained a few of the phrases from the large variety passage repeated several times, while the large variety passage contained different passages instead. Thus, the large variety involved more different ways of using the new word. The same principles were used in constructing sets of six sentences to represent the difficult passages. The large variety consisted of six different sentences; the small variety, three different sentences. Two nonsense words were used in the easy concept passages and two different nonsense words were used for the difficult passages. Appendix B contains the eight different sets of materials used. The assignment of nonsense syllables to concepts was such that one of two nonsense words was always assigned to each concept. As will be apparent from the experimental design, a single subject never received more than one passage or list of sentences for each concept.

A generalization test which also appears in Appendix B was designed for each of the four concepts. The phrases that repeated parts of the original passage were always the phrases that had appeared as part of the small variety condition, and therefore, were also included in the large variety condition. The new phrases that were included were new with respect to both the small and large variety conditions. Generalization lists were constructed consisting of sentences containing the new word which were to be accepted (called OK by the S) or rejected

(called silly by the S). The sentences included controlled amounts of the original and new materials and thus the tests for each of the paired concepts are comparable. The same sentences were used for the large and small variety conditions. The generalization test is reproduced in Appendix B. The answer key refers to the way in which a S who was able to use the new word appropriately would respond.

The 4th and 5th grades were provided with an answer sheet on which to write their responses (silly or OK) but the Kindergarten Ss were given a special answer sheet. It contained two rows of faces. More specifically, beside the number corresponding to each test sentence were pictures of a silly face and a pretty face. The S was to place a mark over the face that was silly or the face that was OK. The instructions were also accompanied by this type of response sheet. The same two faces were used throughout but their left-right position was varied randomly from sentence to sentence in order to avoid a place response set (see Appendix B).

Experimental Design: Easy Task

The experimental design for the easy task consisted of eight independent groups of Ss of each of two grade levels. Four groups at each age level received intentional instructions and the other four received incidental instructions. In addition, there was one repeated measure, variety. All Ss in all groups received two concepts, newspaper and train, one presented by a large variety, and the other presented by a small variety. Half of the groups received the small variety concept first and the other half received the large variety concept first. All Ss received both concepts under the same instructional set. Two nonsense names were assigned so that each name appeared in place of newspaper and train an equal number of times. Fourteen 4th and 5th grade Ss were selected to represent each independent group, and fourteen Kindergarten Ss were selected. An attempt was made to equate the eight Kindergarten groups and the eight older groups for mean M.A. and variance.

Thus eight Kindergarten groups and eight 4th and 5th grades received the two easy concepts. Appendix B contains the assignment of nonsense names to concept in the eight conditions. Groups A through H are listed, and it will be noticed that with the exception of set, A is equivalent to E, B to F, C to G and D to H. In the relevant sections to follow, A and E are designated A etc.

Experimental Design: Difficult Task

Four of the older groups who received the easy task also received the difficult task. The difficult task consisted of a second pair of concepts which was also administered to four new groups in a balanced design. Thus eight groups were employed for the analysis of the difficult task. All Ss received the incidental set for the first pair of concepts; half received the intentional set for the second pair, and the other half received the incidental set for the second pair. As before, all Ss received both concepts, one presented through a large variety of different instances, and the other presented through a small variety. Both variety conditions were presented to each S under the same instructional set, half of the Ss received gather first, and half received increase first; half received gather as large variety and half received gather under small variety; and the other concept under the other variety condition. Two nonsense names, hudray and lidber, were employed to represent increase and gather an equal number of times. The group designated AAA in Appendix B is equivalent to EEE in all respects with the exception of set.

Scoring Criteria and Information Relevant to Scoring

Easy Concepts:

The solutions presented by the Ss were scored in accordance with two sets of criteria. The responses which were considered correct for the narrow criterion were, for newspaper:

newspaper, paper, the paper; for train: train. The additional responses considered correct for the broad criterion were, for newspaper: magazine, and for train: truck and pack or carrying animal (e.g., mule, elephant, camel, horse).

The Generalization Test was scored in terms of total number of 'acceptances' and in terms of number of acceptances where acceptance was the correct response.

Difficult Concepts:

Appendix B presents the scoring of various possible correct answers. The responses scored partially correct were always appropriate responses to at least half of the presented sentences, and with the wholly correct responses, they comprised the correct answers for the broad criterion.

Procedure:

Ss were tested in intact classes. The instructions for the two instructional set conditions and the preliminary instructions given to all Ss are reproduced in Appendix B. They contain information concerning how to evaluate sentences as sensible or not. The Generalization Test which follows the two easy concepts requires that the Ss evaluate the sentences as "silly" or "OK" and the instructions provide information about how to make these responses. They were prepared to hear a new word and for intentional set were asked to figure out its meaning. For incidental set, they were asked not to pay any special attention to the new word but merely to relax and try to understand the story.

E read the appropriate instructions, paraphrased them where necessary, and allowed for questions. The paragraph appropriate to the treatment condition was read verbatim in a paced manner. Ss were then directed to "Turn to Word 1; listen carefully, I will not repeat; write silly or OK" (for the Kindergarten group, "mark the silly face or mark the face that is OK") next to the number." The sentences of the Generalization Test were read. Following this the 4th and 5th grade group was instructed to write the definition of the new word. The Kindergarten group was asked to bring their answer booklet up to the front of the room and form two lines. One examiner sat on each side of the room and beckoned to one child at a time to approach and whisper the meaning of the concept to the examiner who, in turn, wrote the response in the child's booklet.

After the paragraph was read, E told the Ss in the intentional condition to listen again to the same story since they might get the meaning the second time if they did not get it the first time. For the incidental condition they were merely asked to listen again the same way as before. Instructions and administration were repeated for both groups.

E then went on to the second paragraph, which was also repeated as was the final sets of sentences. For the 4th grade groups, E then proceeded to the sets of sentences designed to suggest the concepts of gather and increase. The instructions were the same although half of the Ss who received one set were given the other set for the difficult task.

Results

Acquisition of the Concepts

The most general measure of the difference between a small and large variety in effectiveness for promoting concept learning is the comparison between the number of Ss who attained the small variety concept and not the large, and the number who attained the large variety concept and not the small. Attainment is measured by correct solution on either trial 1, trial 2, or both trials. Table 1 presents this information and it is summarized in Table 2.

Concerning the overall effect of variety, the large variety was reliably more effective in two of the samples; for the Kindergarten sample, and for the 4th and 5th grade sample with the difficult task. The frequencies tended in this direction except for the 4th and 5th grade sample to which the easy task was given. Concerning the effect of variety, under the separate set conditions, the Kindergarten sample under incidental set attained the concept in greater numbers with a large variety than with a small. The means tended in the same direction for the intentional set and thus the overall difference between the variety conditions showed a consistent trend ($P < .178$). More 4th and 5th grade Ss attained under large variety for intentional set when the task was difficult. For the broad criterion, fourteen Ss solved under large and only six under small variety ($P < .116$) but for incidental set the trend was reversed. For the narrow criterion, however, the difference was reliable, $P < .112$ with 16 Ss attaining the concept under the large variety, and only 5 attaining under small variety. The values for incidental set are in a consistent direction though not reliable. However, the sums for both sets indicate that 27 Ss solved under large variety and not under small while only 10 Ss solved under small variety and not under large ($P < .02$).

Table 2 presents the number of Ss who got both concepts right/^{at least once} and the number who got both concepts wrong for both criteria, both sets, both tasks, and both age groups. The easy task was clearly easy for the 4th and 5th grades in that more Ss got both concepts right than got them wrong ($P < .01$). However, the task was not easy for the Kindergarten sample in that more Ss got both concepts wrong than right ($P < .05$). The difficulty of the difficult concept appeared to depend upon the criterion in that Ss tended to get both right using the broad criterion, but to get both wrong under the narrow criterion, when set was intentional. No reliable differences due to set were observed.

Using a more sensitive measure of determining whether S performed better on a large or a small variety, comparisons similar to those above were made. Ss were scored for each concept. If they attained the concept on the first trial, they were given 2 points, if they attained the concept for the first time on the second trial, they were given 1 point, and if they never attained it, 0 points. The score for the small variety could then be subtracted from the large variety score as was carried out in Table 3. In contrast to the more crude assessment, more Kindergarten Ss acquired the concept/^{first} under the small variety when the broad criterion was used, and when set was intentional. However, with this exception, the other results for both tasks were similar to the results of the former measure in that more Ss acquired the concept under the large variety than under the small variety. As before, the 4th and 5th grade sample to which the easy task was given tended to perform better under the small variety. Also, for the 4th and 5th grade sample receiving the other task scored by the broad criterion, the small variety tended to be more effective than the large variety for incidental set.

Overall Generalization

Generalization to sentences, regardless of whether such generalization was correct or not, was found to vary widely among conditions. The analyses of variance appear in Table 4. For the 4th and 5th grade sample, variety was found to be a reliable main effect such that the tendency to accept the generalization sentences was reliably greater for the large variety condition than for the small ($P < .01$). Although not reliable, the means tended in the same direction for the Kindergarten sample. The means for the main effects appear in Table 5.

Table 1

The number of Ss within each group attaining the Large Variety concept on either trial and not attaining the Small Variety concept at all & v.v.

Verbal Acquisition Experiment 1
Newspaper and Train; Gather and Increase*

		Group	Intentional				Incidental				Total		
			A	B	C	D	A	B	C	D			
<u>Newspaper - Train</u>													
Kindergarten	Broad Criterion	Only on Large	4	5	2	0	<u>11</u>	0	1	5	5	<u>11</u> ^b	<u>22</u> ^a
		Only on Small	1	2	2	4	<u>9</u>	2	1	1	0	<u>4</u> ^b	<u>13</u> ^a
	Narrow Criterion	Only on Large	4	4	2	1	<u>11</u>	0	1	4	7	<u>12</u>	<u>23</u>
		Only on Small	0	4	2	4	<u>10</u>	3	1	2	0	<u>6</u>	<u>16</u>
4th-5th	Broad Criterion	Only on Large	2	0	0	1	<u>3</u>	0	0	0	3	<u>3</u>	<u>6</u>
		Only on Small	4	1	1	0	<u>6</u>	2	2	1	1	<u>6</u>	<u>12</u>
	Narrow Criterion	Only on Large	2	0	0	4	<u>6</u>	2	0	0	6	<u>8</u>	<u>14</u>
		Only on Small	4	2	1	0	<u>7</u>	2	6	2	1	<u>11</u>	<u>18</u>
<u>Gather - Increase</u>													
4th-5th	Broad Criterion	Only on Large	3	2	2	7	<u>14</u> ^d	3	1	0	3	<u>7</u>	<u>21</u>
		Only on Small	0	4	2	0	<u>6</u> ^d	1	5	5	2	<u>13</u>	<u>19</u>
	Narrow Criterion	Only on Large	6	1	1	8	<u>16</u> ^c	5	2	2	3	<u>12</u>	<u>28</u> ^b
		Only on Small	2	2	0	0	<u>4</u> ^c	1	3	2	1	<u>7</u>	<u>11</u> ^b

a P = .178

b P = .004

c P = .112

d P = .116

* Probabilities presented refer to the distribution for the Sign Test and are two-tailed

Note- Intentional and Incidental conditions are only comparable for Totals; Variety frequencies may be compared within set conditions and for Totals
 Same subscripts appear beside the two frequencies being compared

Table 2

Frequency of Concept Attainment
Verbal Acquisition Experiment 1

Newspaper and Train; Gather and Increase

<u>Newspaper and Train</u>		Broad Criterion		Narrow Criterion	
		Intentional	Incidental	Intentional	Incidental
Kindergarten	Only on Large	11	11	11	12
	Only on Small	9	4	10	6
	Both right	13	14	9	10
	Both wrong	23	27	26	28
4th-5th	Only on Large	3	3	6	8
	Only on Small	6	6	7	11
	Both right	44	46	40	34
	Both wrong	3	1	3	3
<u>Gather and Increase</u>					
4th-5th	Only on Large	14	7	16	12
	Only on Small	6	13	4	7
	Both right	25	31	11	18
	Both wrong	11	5	25	19

Note- Intentional and Incidental Conditions may only be compared with respect to Both right and Both wrong; Only on Large and Only on Small may be compared within each set.

Table 3

Frequency of Differences in Attainment Scores of the Large and Small Variety Concepts: Newspaper and Train; Gather and Increase*
Verbal Acquisition Experiment 1

		No Difference'	Large Better			Small Better			
		0	1	2		-1	-2		
<u>Newspaper and Train</u>									
Kindergarten	Broad Criterion	Intentional	34	6	6	<u>12</u>	7	3	<u>10</u>
		Incidental	35	6	6	<u>12</u>	6	3	<u>9</u>
	Narrow Criterion	Intentional	34	8	4	<u>12</u>	6	4	<u>10</u>
		Incidental	32	5	8	<u>13</u>	7	4	<u>11</u>
4th-5th	Broad Criterion	Intentional	39	1 ^c	3	<u>4^a</u>	8 ^c	5	<u>13^a</u>
		Incidental	37	8	2	<u>10</u>	6	3	<u>9</u>
	Narrow Criterion	Intentional	36	2	5	<u>7</u>	7	6	<u>13</u>
		Incidental	27	5	7	<u>12</u>	10	7	<u>17</u>
<u>Gather and Increase</u>									
4th-5th	Broad Criterion	Intentional	34	2	13	<u>15</u>	2	5	<u>7</u>
		Incidental	29	3	7	<u>10</u>	7	10	<u>17</u>
	Narrow Criterion	Intentional	35	0	16 ^d	<u>16^b</u>	1	4 ^d	<u>5^b</u>
		Incidental	32	3	11	<u>14</u>	6	4	<u>10</u>

Key: Differences in Attainment scores were derived by subtraction of the following scores for Large minus Small Variety concepts:

2: Correct on trial 1

1: First correct response on trial 2

0: Never correct

* All reliabilities are based on a two tail Sign Test (Dixon and Massey, p. 418).

a P = .050

b P = .004

c P = .040

d P = .012

Note- Intentional and Incidental Set are comparable for No Difference only ; Large better and Small better may be compared within sets.

Same subscript appears beside the two frequencies being compared

Table 4

Analysis of Variance of Generalization Test:
Total Score as a Function of a Variety, Trial, and Set,
Verbal Acquisition Experiment 1

	df	Kindergarten		Fourth-Fifth	
		MS	F	MS	F
Total	447				
Between	111	813.69	14.06		
Group (G)	3	148.57	2.57 ^a	74.55	.77
Set (S)	1	.00	.00	.01	.00
G x S	3	855.24	14.77**	16.39	.17
Error	104	57.89		97.02	
Within	336	13.24	1.03		
Variety (V)	1	31.61	2.46	70.72	7.69**
Trial (T)	1	13.93	1.08	87.51	9.51**
V x T	1	18.48	1.43	7.00	.76
S x T	1	5.81	0.45	75.57	8.21**
V x G	3	70.76	5.50**	319.60	34.74***
V x S	1	21.00	1.63	4.32	.47
T x G	3	1.10	.0854	.91	.09
V x S x T	1	4.13	.32	7.51	.82
S x T x G	3	10.20	.79	1.31	.14
V x T x G	3	6.93	.54	15.48	1.68
V x S x G	3	17.90	1.39	11.01	1.20
V x S x T x G	3	5.30	.41	5.01	.54
Error	312	12.87		9.20	

a P < .10
** P < .01
*** P < .001

For both samples, the interaction between Variety and Group was reliable $P < .01$ (Table 6). A and B showed less generalization on the basis of large variety than small variety while Groups C and D showed greater generalization on the basis of large variety. Groups A and B were not alike with respect to the assignment of concepts to variety conditions or nonsense syllables to concepts. Their only similarity was that the large variety concept appeared first for these groups while the small variety concept appeared first for C and D.

Although both samples showed greater generalization on the second trial, the differences were only reliable for the older sample. The main effect of trial was significant $P < .01$. Moreover, for that sample, the effect of trial depended upon the set. The interaction of trial and set was reliable $P < .01$. Inspection of Table 7 reveals that for the older sample generalization decreased from the first to second trial when set was intentional, but when set was incidental, generalization decreased. Although the differences between means for the Kindergarten sample were not reliable, generalization tended to increase over trials for both sets.

Although there was no overall difference among the four groups, there was a trend ($P < .10$) for the Kindergarten sample for the groups to be different. However, the interaction of group and set was reliable $P < .01$. Table 7 presents the means for this interaction and it appears that the effects of set on groups A and B are opposed. Groups A and D are similar with respect to the effects of set and groups B and C. The similarity between A and D is that train is the small variety concept while newspaper is the large variety concept. For B and C train is large variety. When train is the small variety concept there was greater generalization under incidental set than under intentional set. However, when newspaper was the small variety concept, there was greater generalization under intentional set.

Generalization to Sentences for which Generalization is Correct

The analysis of variance which is presented in Table 8 reveals that the interaction between variety and groups was significant $P < .01$ for both samples. The means are presented in Table 9. The differences between groups were only reliable for the Kindergarten sample. B showed greater generalization than C. B had received train with a large variety as the first concept while C had received newspaper with a small variety as the first concept. Considering the interaction between variety and group, the least generalization occurred under the small variety for group D for both samples. Train was presented first under small variety. Although the overall effect of variety was not significant, the overall trend was for generalization to be greater under the large variety condition than under the small variety condition, for both samples.

Group and set were found to interact reliably for the Kindergarten sample. The means which appear in Table 9 reveal that groups A and D generalize more under incidental set while groups B and C generalize more under intentional set. Groups A and D received newspaper with a large variety and train with a small variety while the opposite assignment was given to groups B and C.

Table 5
Total Generalization
Main Effects of Variety, Set, and Trial on Total Generalization Score,
Verbal Acquisition Experiment 1

		Kindergarten	4th and 5th
Variety ¹	Small	7.87	8.76
	Large	8.40	9.56
Set	Intentional	8.13	9.17
	Incidental	8.13	9.16
Trial ²	1	7.96	8.72
	2	8.31	9.60
Group	A	9.85	8.80
	B	7.70	9.77
	C	7.60	9.89
	D	7.38	8.18

¹Main effect significant for older group $P < .01$

²Main effect significant for older group $P < .01$

Table 6
 Overall Generalization,
 Means of the Interaction between Group and Variety
 Verbal Acquisition Experiment 1

Group	Kindergargen ¹		4th and 5th ²	
	Small	Large	Small	Large
A	10.45	9.25	9.02	8.59
B	7.91	7.48	10.96	8.57
C	6.57	8.63	9.66	10.13
D	6.54	8.23	5.41	10.95

1. Interaction significant $P < .01$
2. Interaction significant $P < .001$

Table 7
Total Generalization
Means of the Interaction between Set and Other Variables: Groups and Trials
Verbal Acquisition Experiment 1.

Group	Kindergarten		Group x Set ¹		4th and 5th	
	Intentional	Incidental			Intentional	Incidental
A	6.77	12.93			8.34	9.27
B	10.84	4.55			10.23	9.30
C	8.89	6.30			9.84	9.95
D	6.02	8.75			8.25	8.11
Trial x Set ²						
Trial 1	7.84	8.07			9.13	9.20
2	8.42	8.20			8.30	10.01

¹Interaction significant for Kindergarten sample $P < .01$

²Interaction significant for 4th and 5th Grades sample $P < .01$

Table 8

Analysis of Variance of Generalization as a Function of Set and Variety:
 Verbal Acquisition Experiment 1 Sentences in which Acceptance is Correct

Source	df	Kindergarten		4th & 5th Grade	
		MS	F	MS	F
Total	223				
Between	111				
Group (G)	3	71.59	1.34	189.18	4.39*
Set (S)	1	5.47	.10	40.29	.93
G x S	3	727.65	13.59**	26.31	.61
Error	104	53.54		43.11	
Within	112				
Variety (V)	.1	47.36	2.06	72.00	2.81
V x G	3	124.73	5.42*	589.77	22.99**
V x S	1	14.50	.63	26.47	1.03
V x S x G	3	52.04	2.26	28.09	1.10
Error	104	23.03		25.65	

* $P < .01$

** $P < .001$

Table 9

Generalization to Sentences in which Acceptance is Correct
 Means of the Interaction between Group and Variety¹,
 and Group and Set², and the Main Effects
 Verbal Acquisition Experiment 1

Group	Kindergarten			4th and 5th		
	Small Variety	Large Variety	Mean	Small Variety	Large Variety	Mean ³
A	13.21	10.54	11.88	15.68	16.18	15.93
B	10.46	10.07	10.27	21.14	15.71	18.43
C	7.96	11.32	9.64	18.25	17.64	17.95
D	7.64	11.04	9.34	9.43	19.50	14.46
Mean	9.82	10.74		16.13	17.26	

Group	Kindergarten		4th and 5th	
	Intentional Set	Incidental Set	Intentional Set	Incidental Set
A	8.64	15.11	16.11	15.75
B	14.36	6.18	19.79	17.07
C	11.96	7.32	17.68	18.21
D	6.79	11.89	14.89	14.04
Mean	10.44	10.13	17.12	16.27

1. Interaction significant $P < .01$ for both groups.
2. Interaction significant $P < .01$ for Kindergarten group.
3. Main effect of group significant for older sample $P < .05$.

Discussion

Acquisition of the Concept

In general, the results of Verbal Acquisition experiment 1 indicated that the large variety was more effective in promoting concept attainment than the small variety. This tended to be true for all the Kindergarten groups except one. When the broad criterion was used and the more sensitive method of determining the difference between variety, the small variety led to the solution by more Ss than did the large variety. It would seem that the difference in scoring methods is crucial here. It is likely that the small variety led to some incorrect or partly incorrect concepts which were verbalizable. If concepts were verbalized at all in the large variety, they were more likely to be adequate rather than partially acceptable. But for the small variety there must have been more partially acceptable concepts than for the large variety.

The large variety was not more effective in promoting concept attainment for the 4th and 5th grades with the easy task; in fact, the consistent trend is for the small variety to be superior in this case. It would appear that this result is related to the fact that this task was so easy for the 4th and 5th graders. Those few who did not attain both concepts were probably less adequate intellectually than the others or those for whom this type of task presented a special problem. Thus, it is possible that for those of limited intelligence, or those to whom a very difficult task is given, a small variety is more effective. Since the trend was most clearcut under the narrow criterion and for incidental set, these may be contributing factors.

The large variety was clearly more effective in promoting concept attainment for the 4th and 5th grades to whom the difficult task was given. The difference between the large and small variety conditions is generally more marked for the narrow criterion than for the broad criterion. In addition, the advantage of the large variety appears to be greater for intentional set; small variety is more beneficial for incidental set when the broad criterion is employed.

Generalization

Generalization tended to be greater under the large variety conditions than the small for both samples, and for both measures of generalization although the effect was only statistically significant for overall generalization and for the older sample. The hypothesized interaction between variety and set was not evident. For overall generalization, the variety difference was greatest when the large variety concept followed the small variety concept. For generalization to instances for which generalization was correct, it was also found that for one of the conditions in which the large variety concept followed the small variety concept, the generalization to small variety was minimal while to the large variety concept it was relatively large. This suggests that Ss are relatively cautious on the first trial and more ready to generalize later if the variety condition is large. This notion was more strongly corroborated with respect to sequence of trials than with respect to sequence of concepts. The main effect for trials was only reliable for the older sample and using the overall generalization measure. In the case of trials, the effect may be due to a tendency to be cautious at the outset, but it might also be affected by the fact that the same sentences were repeated for trials one and two. After having heard the new words used in these sentences, a S might accept this use more readily because by the second test trial, the usage is no longer new, but familiar. The fact that overall generalization increased from the first to the second trial when set was incidental but not when set was intentional seems consistent with this familiarity explanation. It would be expected that response under incidental set would be more dependent on familiarity than responses under intentional set under which Ss would be actively trying to form a concept and might thus be less readily influenced to accept and recall the context in which a word was used erroneously.

Verbal Acquisition Experiment 2

Subjects

Six 4th and 5th grade classes in Berkeley, California, served as Ss. Two of the classes were tested as wholes and only half of each of the other four tested. Two halves of a Kindergarten class were also tested, but sixteen Kindergarten children and 34 older children were used as Ss.

Materials

The materials consisted of six sentences employing each of eleven concepts which ranged in difficulty as estimated on an a priori basis. The concepts were finish, light (referring to illumination), soft, dream, obstacle, stick, happiness, stones, hole, courage, faults. Hole was not used in processing the results. Appendix C contains these materials.

Experimental Design

A mixed design was employed in three separate two-group studies, 2A, 2B, and 2C. They could be considered three separate studies, but are so closely related that it seems warranted to treat them as one. An intentional set was used throughout. The repeated measure in each of the three studies was variety (the number of different sentences used to exemplify each concept). The experimental variable for the independent groups was merely the particular concepts chosen for the large and the small variety. For example, if one of the groups had the concepts happiness, stick, dream, light, and courage with small variety and the other five concepts with large variety, then the other group had the former set of five concepts with large variety and the remainder with the small variety. The sequence in which each of the concepts was received was identical for two of the groups within each of the three studies. Initially, four of the six groups were run. Two of these were given a small variety consisting of two different instances repeated three times. The other pair of groups received a small variety consisting of three different instances repeated twice. Both groups received a large variety of six different instances. After the experiments were run, it was decided to replicate the experiment employing the three instance small variety condition. Two new groups received the same sentences to represent the small variety and the same concepts to represent each variety condition as done for the first pair of groups. However, the sequence of presentation of sentences within concepts was different from the original groups. Appendix C contains the assignment of sentences to variety conditions in each subgroup. The entries in the table indicate the sequence in which the particular sentence was presented. The numbers corresponding to the sentences refer to the preceding table in which the stimulus materials are presented.

The assignment of groups to conditions is such that groups A and B are complementary, groups C and D are complementary and groups E and F are complementary. Groups C and E are virtually replicates of one another, and groups F and D also.

Procedure

Instructions were read to Ss in intact groups. A sample problem was presented and discussed. These materials are reproduced in Appendix G. Briefly, the Ss were asked to listen to two (or three) sentences at a time which contain a "new" word, and then to write the English word(s) which they feel corresponds to the "new" word. For groups A, B, C, and D, three sentences were read to the Ss, they were requested to write their definition of the "new" word; three more sentences were read and they were again asked to write a definition. For the small variety condition, the same three sentences were repeated, but for the large variety condition, three new sentences were read. For the other two subgroups, E and F, two sentences were read; the Ss were requested to write their definition; two sentences were read; Ss were again requested to write the definition; two more sentences were read and the Ss wrote their definitions.

The procedures were administered to the Kindergarten children in the same manner, but they were asked to come up, one by one, to E and whisper the meaning of the concept in E's ear. They volunteered to come up and whisper.

Scoring

Groups A, B, C, and D were tested for their knowledge of the concept after presentation of 3 sentences and again after presentation of six sentences. They were given one point for each correct definition after six sentences. Groups E and F were tested for their knowledge of the concept after presentation of 2, 4, and 6 sentences. They were given one point for each correct response at the end of 6 sentences. In this way the responses for the two-instance and three-instance variety conditions are comparable. The number of concepts involved is quite small; thus it was not possible to compare statistically the number of improvements from one trial to the next.

Results, Kindergarten Sample

Since many of the scores were 0 and the range of scores was 0-3, it was not possible to perform an analysis of variance on the Kindergarten data. For group E the mean number of small variety concepts attained was .38 and for the large variety concepts, .47. For group F the mean number of small variety concepts was .41 and large variety was .50. The overall mean for small variety was .78 and for large variety, .97.

Results, 4th and 5th Grade Sample

Table 10 presents the analysis of variance which were performed. There was a trend for the difference between the large and small variety conditions to differ significantly ($P < .10$) which was overshadowed by the larger differences due to sequence and assignment of concept to variety conditions. However, as shown in Table 11, the overall differences between means reveal the large variety to facilitate concept acquisition. It is clear that the differences between variety conditions are due to the second set of 3 sentences. Table 12 presents the frequency with which each concept was acquired on each test trial separately. The difference between the number of large variety concepts attained first on trial 2 (23) and the number of small variety concepts attained first on trial 2 (7) is significant $P < .05$.

Discussion

Serious difficulties arose during the administration of this experiment to the Kindergarten Ss, and it was decided to regard this as a pilot study. Children frequently reported forgetting the answer they were going to whisper. They tended to lose interest and talk among themselves since much time passed between the time the first child whispered and the last child whispered. Also, the latencies varied among trials and among Ss, and may add immeasurably to the variance, besides being confounded with other variables, e.g., confidence.

The procedure worked well with the older Ss, but further controls for the particular selection of small variety sentences are needed.

Table 10

Analyses of Variance: Number of Concepts Acquired as a
Function of Variety, Verbal Acquisition Experiment 2

Source	Very Small Variety			Small Variety		
	df	MS	F	df	MS	F
Total	63			103		
Between	31	5.77	.61	51	7.09	1.71
Group (G)	1	36.00	3.78 ^a	3	16.55	2.55
Error	30	9.53		48	6.50	
Within	32			52		
Variety (V)	1	4.56	1.43	1	8.65	3.31 ^a
G x V	1	18.06	5.68*	3	38.81	14.87**
Error	30	3.18		48	2.61	

^a P < .10

* P < .05

** P < .001

Table 11

Mean Number of Concepts Attained under each
Variety Condition, Verbal Acquisition Experiment 2

	Very Small Variety	Large Variety		Small Variety	Large Variety
Group			Group		
A	1.59	1.95	C	1.23	2.54
B	1.82	3.19	D	1.54	.77
			E	2.15	1.39
			F	1.39	2.77
Mean	1.70	2.54		1.57	1.87

Table 12

Analysis of Responses by Concept, three-item Small Variety,
Verbal Acquisition Experiment 2

Large Variety													
Finish	Light	Soft	Dream	Obstacle	Stick	Happiness	Rocks	Courage	Fault	Total			
B	C	A	D	B	C	A	D	A	D	A	D		
Correct on both	5	6	5	8	4	2	3	6	-	-	2	4	74
Correct first on 2	-	1	2	1	-	5	3	1	-	1	-	2	23
Correct on 1, wrong on 2	-	-	1	-	1	1	1	1	-	1	1	-	10
Incorrect on both	8	6	5	4	8	5	6	5	13	12	11	7	153
Small Variety													
A	D	B	C	A	D	B	C	A	D	B	C	B	C
Correct on both	8	10	1	6	5	7	4	-	-	-	2	2	77
Correct first on 2	-	-	-	-	-	-	-	-	-	-	1	-	7
Correct on 1, wrong on 2	-	-	-	2	1	6	-	2	-	1	-	-	14
Incorrect on both	5	3	12	5	7	-	9	11	13	13	13	10	162

III. Perceptual Recall Experiments

Perceptual Recall Experiment 1

Characteristics of the Subjects

The experimental procedures were carried out in the same 16 classes to which the first task of Word Test I was administered. Sixty-four Kindergarten Ss and 88 fourth-fifth grade Ss were actually used in processing the data. The verbal Acquisition Experiment 1 was always administered before the Perceptual Recall Experiment 1.

The SRA Primary Mental Abilities scales were used in determining mental age. Since the particular Ss used for the Perceptual Recall Experiment 1 differ in some cases from those used in the Verbal Acquisition Experiment, the particular M.A.s differ from the other estimates. The mean M.A. of the Kindergarten Ss was 6'4", and the range was 4'10" to 7'9". The chronological ages ranged from 4'11" to 7'2". The mean M.A. of the 4th and 5th grade sample was 12 years, and the range was 9'1" to 11'9". The chronological ages ranged from 9'4" to 11'9". The mean M.A. and range for each cell of the experimental design appear in Appendix D.

Materials

The experimental materials consisted of booklets containing eight pages of "flags," a blank page and two response pages. Although the particular forms on the eight pages varied among booklets in a manner to be described, all Ss were shown four geometric forms on each page of the booklet. The forms were circle, square, triangle, and star. Each could appear in two sizes; four colors, red, green, yellow, and blue; four positions, upper right (UR), lower right (LR), upper left (UL), lower left (LL); on four different background patterns. Each booklet contained all four forms, one in each color. The forms and the background patterns were printed on gummed paper, and the flag outline was printed on otherwise blank sheets of paper. The pages of the booklets were made by sticking the four labels to each flag outline. Each page always had four different labels in one of two ways. The colored forms were then stuck to the labels such that each form appeared on a different printed background. The background patterns remained in the same position on each page of a given booklet. (See Appendix D).

The position or size of a particular form could vary from one page of one booklet to another page of the same booklet. There were four different Complexity Levels which referred to the extent of this variation. One form of one color was assigned to each of the four Complexity Levels. The Complexity Levels are:

Complexity Level	Position	Size
1	fixed	fixed
2	alternating	fixed
3	fixed	alternating
4	alternating	alternating

For example, if a yellow square was assigned to Complexity Level 1, it would appear on the same position on every page in that booklet e.g., LR and always be the same size. If a red circle was assigned Complexity Level 2 it might appear either in the UR position or the UL position, and would always be the same size. If a blue star were assigned Complexity Level 3, it would always appear in the same position, e.g., LL but would be small on some pages and large on other pages. Finally, a green triangle at Complexity Level 4 might appear in either the UR position or the UL position, and would be small size on some pages and large in others.

The particular assignment of shapes to positions, colors to shapes, and shapes to complexity levels was made with the aid of a Graeco-Latin Square (Lindquist, p.265) such that sixteen different color-form complexity level-position assignments were made. These sixteen different assignments are called object assignments. Thirty-two different booklets were constructed on the basis of these assignments. Half of these were large variety booklets and the other half were small

variety. Each booklet represented one of the sixteen object assignments. For each assignment there were eight possible ways of making a page, and the pages of the large variety booklets corresponded to these. Thus, each page was different from every other page. For the small variety, however, each page was repeated such that only two different pages were selected from the eight possible pages, and each of these was repeated four times. For every large variety booklet there was a small variety booklet which corresponded to it in the particular assignment of objects. The selection of two pages for the small variety was random with the restriction that the two selected reflected alternatives required for Complexity Levels 2, 3, and 4.

Procedure

Two sets of instructions were prepared, one for the Intentional Set and the other for the Incidental Set. E read the instructions appropriate to the conditions, and paraphrased them where necessary. In the intentional instructions the Ss were told that they were to "notice the things which are in all the flags they will see" while in the incidental instructions, they were asked to "notice how well you like each one." The verbatim instructions are presented in Appendix D. Ten seconds were given for viewing each of the eight pages in the booklet. Then the S was asked to open an envelope which contained eight white forms; the same four shapes in each of two sizes. He had always seen six of the eight forms in the same size and in color. He was asked to open the envelope which, to his surprise, contained crayons, and to crayon the forms as they had been colored in the booklets. There were eight crayons in the standard crayon box. Next, he opened an envelope which contained the background labels. He was to lay them out on a blank page as if to make a flag and place the appropriately colored forms on top of the proper label which was set in the proper position. He was to lick the form and stick it to the label. Then he was to open the booklet to a page with an outline flag on it and stick on it the background labels to which the colored forms had already been fastened. That page was removed from the booklet and collected.

The procedure of viewing the eight pages with the same directions was repeated, and another new flag was constructed by the S.

Screening for Color Blindness

Following the experimental procedure, sheets of paper containing colored forms identical to those which had appeared in the booklets were distributed to the Kindergarten pupils. They were instructed to color in an area beneath with a crayon of the same color. The fourth and fifth grade children were shown these sheets and asked to reproduce this color on their sheet. Also they were shown crayons, one at a time, and asked to write the name of the color. One error was allowed.

Scoring

The flags constructed by the S were scored by two independent scorers using a standard scoring sheet. The scoring was entirely objective for the fourth and fifth grade pupils, but the two independent scorers were required because of the high incidence of errors. However, for the Ss there were cases where the scorers disagreed, and a third judge was brought in in order to derive a majority opinion.

Eight points were scored with respect to each of the possible parts of each flag. They concerned the number of forms which were correctly placed (anywhere) on the flag; the number of correct colors placed on the forms (if two forms were colored red, a correct color, only one point was given); the correctness of the assignment of color to form (if a red square was colored red, one point was given, regardless of whether the square was placed in the correct position); the correctness of the color of the shape replaced in the envelope; the correctness of the placement of the form on the background; the shape placed in the correct quadrant of the flag; the color placed in the correct quadrant; the color placed on the correct background label. The directions for scoring the eight categories appears in Appendix C. The scoring was recorded in such a way that separate scores could be derived for the forms of each complexity level.

Results

For the Kindergarten sample the only reliable F ratio corresponded to the difference between intentional and incidental set (see Table 13). The F ratio was reliable $P < .05$ for the difference score and $P < .01$ for Trial 2, but was not reliable for Trial 1. For the difference score, the mean difference (Trial 2 minus Trial 1) for intentional set was 2.56 while the corresponding difference for incidental set was .47. The means for the variety and set conditions for all three measures appear in Table 14. For Trial 2 the mean for intentional set was 14.88 and for incidental set 11.91. Interaction means are shown in Table 15.

For the 4th and 5th grade sample also the only reliable F ratio corresponded to the difference between intentional and incidental set (see Table 16). However, while the Kindergarten Fs were reliable for the difference score and for Trial 2, the 4th and 5th grade Ss' F was reliable for Trial 1. For the partial sample (complete sample) the mean for intentional set was 20.41 (19.57) and for incidental set 16.15 (16.25). For the difference score the mean for intentional set was 3.09 (3.61) while the mean for incidental set was 5.34 (4.57). For Trial 2 the mean for intentional set was 23.56 (23.18) and for incidental set, 21.47 (20.80).

Discussion

The fact that Intentional Set produced superior recall on the first trial for the older Ss but did not do so until the second trial for the younger Ss suggests that the effects of set may not become apparent immediately for the younger child, but may await further learning. For him, it may be necessary to learn how to go about a task before an intentional set can be of benefit. For the older child the intentional set was facilitative only at the outset. Perhaps children under both set conditions discovered the test, and thus both adopted an intentional set for the second trial. If this also happened to the Kindergarten child, it must have been that having adopted the set for the first trial aided their ability to use the set for the second trial.

It is of interest that the Kindergarten child was benefited by the intentional instructions since it is thought that he has few relatively different modes of approach to problems in his repertory, and thus should respond in much the same way under diverse instructional sets. However, such was clearly not the case in the present study in that the particular instruction did affect the recall of Kindergarten children.

Table 13
Analyses of Covariance: Perceptual Recall Experiment 1
Kindergarten Sample

Source	df	Trial 2 minus 1			Trial 1			Trial 2		
		MS	MS' adjusted	F	MS	MS'	F	MS	MS'	F
Variety (V)	1	15.01	15.68	.96	.02	.14	.01	17.02	19.85	.95
Set (s)	1	70.14	72.18	4.42*	11.39	14.29	.65	141.02	153.53	7.32**
V x S	1	21.39	21.66	1.33	3.52	3.84	.17	40.64	44.46	2.12
Error	60	983.44	16.34							
Total	63				1343.31	22.00		1300.56	20.97	

Table 14

Summary of Mean Recall Scores for Main Effects
Perceptual Recall Experiment 1

		Trial 1 Minus Trial 2				Trial 1				Trial 2			
		Kindergarten	4th & 5th Partial Sample	4th & 5th Complete Sample	Kindergarten	4th & 5th Partial Sample	4th & 5th Complete Sample	Kindergarten	4th & 5th Partial Sample	4th & 5th Complete Sample			
Relevant Variety:	Small	2.00	3.69	3.96	11.91	19.06	18.55	13.91	22.81	22.50			
	Large	1.03	4.75	4.23	11.88	17.50	17.27	12.88	22.22	21.48			
	Set: Intentional	2.56	3.09	3.61	12.31	20.41	19.57	14.88	23.56	23.18			
Incidental	.47	5.34	4.57	11.47	16.16	16.25	11.91	21.47	20.80				

Table 15
Mean Recall Scores: Perceptual Recall Experiment 1

Kindergarten						
	Trial 2 minus 1	Trial 1	Trial 2			
Intentional Set	3.63	12.56	16.19			
Small Variety						
Incidental Set	.38	11.25	11.63			
Intentional Set	1.50	12.06	13.56			
Large Variety						
Incidental Set	.56	11.69	12.19			
4th and 5th Grade						
	Partial Sample			Complete Sample		
	Trial 2 minus 1	Trial 1	Trial 2	Trial 2 minus 1	Trial 1	Trial 2
Intentional Set	2.81	21.19	24.13	3.73	20.45	24.18
Small Variety						
Incidental Set	4.56	16.94	21.50	4.18	16.64	20.82
Intentional Set	3.38	19.63	23.00	3.50	18.68	22.18
Large Variety						
Incidental Set	6.13	15.38	21.44	4.96	15.86	20.77

Table 16
4th and 5th Grade Sample
Analyses of Covariance, Perceptual Recall Experiment 1
Trial 2 minus Trial 1

Source	df	Partial Sample			df	Complete Sample		
		SS	MS' adjusted	F		SS	MS' adjusted	F
Variety (V)	1	18.06	17.63	.57	1	1.63	2.18	.07
Set (S)	1	81.00	86.53	2.79	1	20.05	30.25	.98
V x S	1	4.00	4.00	.13	1	5.50	6.09	.20
Error	60	1867.88	31.00		84	2636.10	30.91	
Total	63				87	2663.27		
Trial 1								
Variety (V)	1	39.06	41.14	1.35	1	35.64	32.29	1.03
Set (S)	1	289.00	240.85	7.88**	1	242.23	303.56	9.64**
V x S	1	0	.00	.00	1	5.50	6.32	.20
Error	60	1916.88	30.56		84	2717.91	31.48	
Total	63				87	3001.27		
Trial 2								
Variety (V)	1	5.64	6.68	.28	1	23.01	24.20	.95
Set (S)	1	70.14	43.74	1.83	1	125.28	71.26	2.79
V x S	1	4.52	4.52	.19	1	21.01	23.76	.93
Error	60	1571.69	23.91		84	2367.68	25.57	
Total	63				87			

** P < .01

Perceptual Recall Experiment 2

Materials for the Kindergarten Sample

Eight different large variety booklets and eight different small variety booklets were constructed. In this experiment variety refers to the irrelevant forms. The same flag outlines, forms, and background patterns were employed as in Perceptual Recall Experiment 1. Four forms were placed on each page such that within each booklet every page was the same in every way. In addition, three irrelevant forms were added to these four constant forms. They were always placed in a column in the center of the flag. The difference between the large and small variety booklets consisted in the amount of variety in the irrelevant forms. For the small variety, two sets of three irrelevant forms were repeated on each of the eight pages of the booklet such that the entire booklet had only two different pages, each repeated four times. For the large variety a different set of three irrelevant forms appeared on each page; thus, each page was different.

The irrelevant forms were selected on the basis of the forms which were not used as relevant forms in the particular booklet. Eight sets of four objects were selected as the relevant object sets with the aid of the Graeco-Latin Square used for Experiment 1. Reference to Appendix D reveals that the sixteen types of booklets in that design were arranged in four Latin squares, Q, R, S, and T. Only Q and R were used for the present experiment, and the selection of the particular page of each booklet was done in the following manner. The first page in each of the eight Q and R booklets in which one small figure and three large figures appeared was selected and copied eight times for the eight pages of the small variety booklet for Experiment 2 and eight more times for the large variety booklet. The irrelevant forms were selected as follows: The possible forms consisted of each form in each size and in each color. There were 28 possible color-forms and subtracting the 4 objects used for a given booklet, 24 possible forms for the irrelevants remained. For the large variety sets of three were selected at random without replacement so that all 24 were used in each large variety booklet, but for the small variety booklet, two sets of three were selected at random and each was repeated on four pages of the booklet. Thus there were eight small variety booklets and eight large variety booklets corresponding to them.

Materials for the 4th and 5th Grade Sample

Thirty-two different booklets were prepared of which half were small variety and half were large variety as defined for Experiment 1. In addition, half of the small variety contained a small variety of irrelevant forms while the other half of the large variety booklets contained a large variety of the irrelevant forms. Similarly the large variety booklets were either large or small variety with respect to the irrelevant forms. As for the Kindergarten booklets, the Q and R Latin Squares which were employed for Perceptual recall experiment 1, were used for the present experiment. These two Latin Squares were used to construct booklets for perceptual recall experiment 1. The same sixteen booklets, eight small variety and eight large variety, are used as materials for experiment 2. The sixteen booklets were duplicated in order to obtain two booklets of each type; making thirty-two booklets in all. Three irrelevant forms were then added to each page of each booklet in the center row of the flag. The method of assignment of the small and large variety irrelevant forms was identical to that described under materials for the Kindergarten sample.

Experimental Design for the Kindergarten Sample

The design involved independent treatment groups in which two levels of variety of the irrelevant forms and set were employed, and eight types of booklet. However, since there were only 32 Ss, eight in each cell, booklets were confounded with Ss. In addition, each S received two trials.

Variety of Irrelevant Forms

		Small	Large
Set	Incidental		
	Intentional		

Experimental Design for the 4th and 5th Grade Sample

The design involved independent treatment groups in which two levels of variety of the relevant forms, two levels of instructional set, and two levels of variety of the irrelevant forms were employed. There were eight types of booklets, each S received two finals.

		Variety of Relevant Forms			
		Small		Large	
Variety of Irrelevant Forms:		Small	Large	Small	Large
Incidental Set					
Intentional Set					

Subjects

The Kindergarten sample consisted of 32 Kindergarten pupils from the Berkeley Public Schools ranging in age from 4'11" to 5'11". The mean M.A. was 6'4" with a range from 5'5" to 7'4". In order to derive this sample, two Kindergarten classes were tested with the PMA and administered the procedures of the Perceptual Recall Experiment. The experimental procedures were administered to children in groups of 5 to 8 and the Ss within the cells were assigned in advance in order that the four cells of the experimental design contain Ss comparable in mean M.A. and variance. The mean M.A. of the Ss in the four subgroups ranged from 6'3" to 6'5".

The 4th and 5th grade sample consisted of 64 pupils from the Berkeley Public Schools ranging in age from 9'3" to 11'5". The mean M. A. was 11'9" with a range of 9'0" to 15'7". The range of the mean M.A. of the subgroups was 10'9" to 12'6". These Ss were not matched for M.A.

Procedure

The second Perceptual Recall Experiment was administered in exactly the same way as the first.

Results

Although there were no reliable F ratios for Perceptual Recall Experiment 2, there was a strong trend for the difference between sets to be significant for the Kindergarten sample ($P < .10$). Tables 17, 18 presents the analyses of covariance. The mean recall score for Trial 1, intentional set, was 8.94 while the mean for incidental set was 7.69. For the older Ss the corresponding mean for intentional set was 15.31 and for incidental set, 13.59. As may be seen from the means in Table 19, the Kindergarten Ss tended to perform better on the first trial than the second, and there was some evidence of this among the 4th and 5th grade Ss also. There was a trend for the intentional set to produce better recall than the incidental set. For the older sample, Trial 2, the mean for intentional set was 16.02 and for incidental set 15.06. There was a trend for the older Ss to whom relevant variety was administered as a treatment, for large variety to be more facilitative of recall than small variety. However, the opposite tended to be true of irrelevant variety for the older sample, and for the younger sample, Trial 1 only. The means for the main effects of Trial 2 appear in Table 20.

Discussion

The fact that Ss, particularly Kindergarten Ss, tended to do more poorly on Trial 2 than on Trial 1 may be due to the nature and scoring of the test. Each page of the stimulus booklet contained seven forms, but Ss were asked to put only four forms on the test page. If they had attempted to remember the irrelevant forms, they would have placed these on the booklets instead of the relevant ones, and thus lost points. For the Kindergarten Ss, the only constant forms were the four they were supposed to place on the booklet, but they also were exposed to the three irrelevant ones. Placing the irrelevant forms on the test blank is clearly an error for that group.

Table 17

Analyses of Covariance: Perceptual Recall Experiment 2

Kindergarten Sample											
Source	df	Trial 2 minus 1			Trial 1			Trial 2			
		MS	MS'	F adjusted	F	MS	MS'	F	MS	MS'	F
Variety of Irrelevants (I)	1	18.00	18.31		2.44	8.00	8.05	1.90	2.00	.08	.01
Set (S)	1	4.50	5.62		.75	12.50	12.85	3.03	2.00	1.48	.21
I x S	1	1.13	1.27		.17	3.13	3.16	.75	8.00	7.84	1.12
Error	28	218.25	7.50			119.25	4.24		201.50	7.03	
Total	31										

Table 18

Analysis of Covariance: Perceptual Recall Experiment 2

4th and 5th Grade Sample

Trial 2 minus Trial 1				
Source	df	SS	MS'	F
Irrelevants (I)	1	4.00	4.21	.14
Set (S)	1	9.00	8.44	.29
Variety (V)	1	5.06	4.85	.16
I x S	1	7.56	6.80	.23
S x V	1	1.00	1.07	.04
I x V	1	49.00	48.23	1.64
I x S x V	1	10.56	10.23	.29
Within	56	1651.25	29.48	
Total	63	1737.44		
Trial 1				
Irrelevant (I)	1	3.52	4.75	.20
Set (S)	1	47.27	50.02	2.10
Variety (V)	1	23.77	22.10	.93
I x S	1	0.02	0.07	.00
S x V	1	0.14	0.29	.01
I x V	1	11.39	8.44	.35
I x S x V	1	21.39	22.73	.95
Within	56	1338.38	23.83	
Total	63	1445.86		
Trial 2				
Irrelevant (I)	1	15.02	17.88	.67
Set (S)	1	15.02	17.36	.65
Variety (V)	1	50.77	47.65	1.79

Source	df	MS	MS'	F
I x S	1	8.27	5.61	.21
S x V	1	1.89	2.46	.09
I x V	1	13.14	16.33	.61
I x S x V	1	1.89	2.46	.09
Within	56	1495.88	26.61	
Total	63	1601.86		

Table 19

Mean Recall Scores: Perceptual Recall Experiment 2

Interactions of Variety and Set

	<u>Kindergarten</u>		
	Trial 2 minus 1	Trial 1	Trial 2
Intentional Set	-.25	8.13	7.88
<u>Irrelevant Variety: Small</u>			
Incidental Set	.88	7.50	8.38
Intentional Set	-1.37	9.75	8.38
<u>Irrelevant Variety: Large</u>			
Incidental Set	-1.00	7.88	6.87
	<u>4th and 5th Grade</u>		
Intentional Set, Small Variety	-.13	16.00	15.88
Incidental Set, Small Variety	.50	13.00	13.50
<u>Irrelevant Variety: Small</u>			
Intentional Set, Large Variety	2.75	15.13	17.88
Incidental Set, Large Variety	2.25	14.62	16.88
Intentional Set, Small Variety	1.25	13.50	14.75
Incidental Set, Small Variety	1.63	12.88	14.50
<u>Irrelevant Variety: Large</u>			
Intentional Set, Large Variety	-1.00	16.62	15.62
Incidental Set, Large Variety	1.50	13.88	15.38

Table 20

Summary of Mean Recall Scores: Perceptual Recall Experiment 2
Main Effects

		Trial 2 minus Trial 1		Trial 1		Trial 2	
		Kinder- garten	4th & 5th Grade	Kinder- garten	4th & 5th Grade	Kinder- garten	4th & 5th Grade
Irrelevant Variety	Small	.31	1.34	7.81	14.68	8.13	16.03
	Large	-1.19	.84	8.81	14.21	7.63	15.06
Variety	Small		.81		13.84		14.66
	Large		1.38		15.06		16.44
Set	Intentional	-.81	.72	8.94	15.31	8.13	16.03
	Incidental	-.06	1.47	7.69	13.59	7.63	15.06

For the older Ss, however, placing the irrelevant forms on the test page is less clearly an error since some of the relevant forms changed characteristics also. For both groups the test blanks should have permitted the Ss to place seven forms in order to get at this problem. However, if we had done this, the results would not have been comparable with those of experiment 1, and they are for the older sample.

The mean scores of the second perceptual recall experiment were clearly lower than those of the first, and the difference between them was larger for the Kindergarten sample than for the older sample. This suggests strongly that the interference produced by the irrelevant forms was more damaging to the younger group. The task of the younger group was simplified in the second experiment which should have operated in the direction such as to minimize any interference which could be detected, but the effect was apparently so great as to be noticeable even under these conditions. In fact, the Kindergarten Ss recalled very few of the features and tended to embellish their response flags with "new" designs. This occurred in the first experiment also, but to a lesser extent.

Table 21

Summary of Means Showing the Interaction of Variety and Set

Insofar as it can be Ascertained for all Experiments

Variety	Kindergarten				4th and 5th Grade ¹			
	Intentional Set		Incidental Set		Intentional Set		Incidental Set	
	Small	Large	Small	Large	Small	Large	Small	Large
<u>Verbal Acquisition 1</u>								
a) # of Ss who only solved under small (large) variety								
Easy Concept:								
Broad Criterion	9	11	4	11	6	3	6	3
Narrow Criterion	10	11	6	12	7	6	11	8
Difficult Concept:								
Broad Criterion					6	14	13	7
Narrow Criterion					4	16	7	12
b) Difference Scores								
Easy Concept:								
Broad Criterion	10	12	9	12	13	4	8	10
Narrow Criterion	10	11	11	13	12	8	17	13
Difficult Concept:								
Broad Criterion					7	15	17	10
Narrow Criterion					5	16	10	14
<u>Verbal Acquisition 2</u>								
a) # concepts acquired								
3-instance small variety					1.57	1.87		
2-instance small variety	.78	.98			1.70	2.55		
<u>Perceptual Recall 1</u>								
a) # elements correctly recalled, trial 1	12.56	12.06	11.25	11.69	21.19	19.63	16.94	15.38
trial 2	16.19	13.56	11.63	12.19	24.13	23.00	21.50	21.44
<u>Perceptual Recall 2</u>								
a) ² # elements correctly recalled, trial 1					14.75	15.88	12.94	14.25
trial 2					15.31	16.75	14.00	16.13
b) ³ # elements correctly recalled, trial 1	8.13	9.75	7.50	7.88	15.56	15.06	13.81	13.78
trial 2	7.88	8.38	8.38	6.88	16.88	15.19	15.19	14.94

¹ Partial sample used for Perceptual Recall Experiment 1² Relevant variety is used for a)³ Irrelevant variety is used for b)

IV. Discussion, Conclusions, and Implications.

Concerning the effects of set

Whenever the experimental task presented a reasonable challenge, as did the easy task of Verbal Acquisition Experiment 1 for the Kindergarten Ss or the difficult task of that experiment for the older sample, there was a tendency for Ss under intentional set to show more adequate concept formation and recall of instances than those under incidental set. For the Kindergarten sample, there was a tendency for this difference between sets to occur under the small variety, but for the older sample it occurred under large variety. Further, for the latter sample, under small variety there was a tendency for performance to be better under the incidental set (for the difficult concept, and for the easy concept with the narrow criterion).

For the Perceptual Recall experiments, the results were relatively clear-cut. For both samples and both experiments performance was improved by the intentional instructions. The trends of the means by no means confirm the hypothesis that the effect of set should be greater for the older sample than for the younger one.

These results concerning set strongly suggest that set is as important a factor among Kindergarten children as it is among older ones and, therefore, intentional instructions should be used suitably to increase learning among children of that age group. However, it does seem that there are differences between the groups with respect to what happens conceptually under each of the sets and it is this problem which we are interested in pursuing. The particular experimental condition with which we have chosen to investigate this problem was amount of variety in the instances of the concept. The particular way in which variety interacts with set should give some further clues concerning the processes employed by children of the two age groups.

Concerning the Interaction between Variety and Set

Although the trends are slight, it appears that for the Kindergarten Ss the decrement under incidental set appears consistently greater for the small variety condition. In most cases, excluding Perceptual Recall Experiment 2, performance was worse for small variety under incidental set. For the older sample, the opposite results tended to obtain for the verbal acquisition experiments but for the perceptual recall experiments, no clear interaction was detectable. However, performance did drop under incidental set for both variety conditions.

In general, for Kindergarten Ss it would seem that variety of instances is not an important variable when set is intentional. However, when set is incidental, large variety tends to produce better concept acquisition and recall. There is a trend for small variety to lead to more efficient concept formation and recall for the Kindergarten Ss under intentional set and to lead to more efficient recall for the older Ss under both sets. Concept memory is thus facilitated by a small variety of relevant instances, and this result is consistent with an S-R interpretation of the intuitive process by which learning takes place.

The results concerning set and variety further suggest that under intentional set the Kindergarten Ss behave similar to the older Ss. It is only under incidental set that their learning processes differ from older Ss. Perhaps they verbalize their perceptions when given such instructions, but do not do so otherwise. The older Ss might well verbalize under both instructional sets. Therefore, the big difference between the two samples may lie in the processes employed in incidental set condition.

For verbal concept acquisition, a large variety of instances is usually more effective than a small variety of instances for both age groups. However, in the special case of very easy concepts which are acquired by a large majority of Ss, more of the Ss who only solved one concept did so under small variety than under large variety. Also, it must be remembered that these Ss may have been the slow learners of the group, and thus small variety may be more effective for this restricted class of students.

Concerning the Verbal Acquisition Experiments

The fact that acquisition tended to be superior under a large variety of instances suggests that this task was carried out with the aid of a deductive process which is facilitated by a large variety. However, it is also possible that the task accomplished with the aid of association. In general, deductions take place only after hypotheses are formed. In this case it is reasonable to assume that the hypotheses are associations made to the sentences. Consequently, a large variety may be more efficient for the generation of hypotheses as well as for the ability to reject false ones.

A large variety of instances was also found to be more facilitating in the acquisition of verbal concepts by pre-school children. Razran (1961) reports that Soviet investigators found that a wide variety of different contexts was more efficient in language acquisition than a small variety.

The limitations of the present experiments are that the probability of the correct response varies from sentence to sentence. Therefore, the probability of the correct response on the basis of two sentences would not necessarily be equal to the probability based on six sentences, or another pair of sentences. Ideally then, all possible combinations of pairs of sentences should be compared with the large variety set, or the probability with which a correct response would occur be standardized for individual sentences before any pairing occurs.

The difficulty of a particular sentence (probability of eliciting the correct response) might depend on a number of factors including the degree of contextual constraint, part of speech of the verbal concept and its context, etc. Aborn, Rubenstein, and Sterling (1959) found for example that the various grammatical classes differ in predictability and that predictability increases up to a point with sentence length regardless of position in the sentence. However, these factors were allowed to vary at random in the present experiments which represented an attempt to deal with variety and set in general, and above other factors which operate in the usual communication situation.

The present experiments may have some bearing on the learning of foreign languages from contexts. They suggest that intent to learn does improve acquisition, even for younger Ss. Although not significant, the results are not in agreement with the notion that foreign languages are best acquired by young children through the kind of usage in which general comprehension of the meaning of the utterance is all that is required. They do support the notion that deliberate attempts to acquire specific word meanings are beneficial, at least during a restricted stage of learning, even in children of Kindergarten age.

Concerning the Perceptual Recall Experiments

Since performance tended to be better under intentional set but no interaction with variety was significant, it is difficult to make any inferences about the processes which might correspond to the two sets. At the very least, it appears that learning is more efficient under intentional set even for the younger child.

The effect of variety depended on whether irrelevant features were present or not. This experiment was not carried out with the Kindergarten sample, but with the older sample the trend was for the effect of variety to be opposite to its effect in the first experiment. Namely, large variety seemed to produce better recall of the relevant features than did small variety. However, this effect may have been brought about by a tendency to recall the irrelevant features; a response tendency which was not assessed in the present investigation.

The fact that the Kindergarten Ss frequently did more poorly on the second trial of the second verbal acquisition experiment than on the first suggests that they may have been learning the irrelevant forms at the expense of the relevant ones. However, inspection of the test booklets and of the magnitude of their scores suggests that they learned very little of this task. They tended to embellish their response flags with designs and "extras" that never appeared in the original stimuli which clearly suggested that they did not understand the task or found it difficult and substituted one of their own. There was less inappropriate behavior in the first experiment.

V. Summary

Problem

Studies were designed to investigate processes of concept formation in children. It was hypothesized that younger children would form concepts in accordance with a relatively passive, intuitive process regardless of instructional set. In contrast, it was hypothesized that the older Ss would also form concepts in this manner under incidental instructional sets, but when the sets were intentional and the situation suitable, older Ss would use more active and formalized deductive processes. Since there are a priori bases for believing that the effect of the number of different instances used to form concepts (variety of instances) would depend on the particular instructional set and the cognitive process in operation, in addition to instructional set, this variable, variety, was studied in children of two ages levels.

Objectives

1. To determine whether the acquisition of verbal concepts is more efficient under an intentional set for Kindergarten children and for children of 4th and 5th grades.
2. To determine whether features common to instances presented for concept formation are better recalled under an intentional set or an incidental set for Kindergarten children and for children of 4th and 5th grades.
3. To determine whether a small or a large variety is more efficient for promoting concept learning in a verbal acquisition task for Kindergarten children and for children of the 4th and 5th grades.
4. To determine whether a small or a large variety is more efficient for promoting recall of features common to instances presented for concept formation for Kindergarten children and for children of 4th and 5th grades.
5. To determine whether the effect of the variety of instances on concept acquisition and recall depends on the instructional set which obtains for Kindergarten children and children of the 4th and 5th grades.
6. To determine whether the breadth of the child's verbal concept depends on the variety or set condition under which it was acquired.

Procedure

Verbal Acquisition Experiment 1. This experiment consisted of two parts, one employed an easy task, and was administered to both Kindergarten and 4th and 5th grade Ss; the other employed a difficult task and was administered to 4th and 5th grade Ss only. For the easy task, eight independent groups of Kindergarten children and eight independent groups of 4th and 5th grade pupils were employed as Ss. They were tested for intelligence and the experimental procedures were administered in intact classes. Eight independent groups of 4th and 5th grade Ss were employed as Ss for the difficult task, and the experimental procedures were administered in intact classes. Only some of those tested served as Ss. Thus 36 independent groups were involved in all. The experimental groups within each set of eight were matched as closely as possible for mean IQ and variance in IQ.

For each set of eight independent groups, four groups received intentional instructions and four received incidental instructions. Each S formed two concepts to which two nonsense names could be attached and which could be presented in a large or small variety. Repeated measurements was employed in that each S received one concept in a large variety and the other in a small variety. However, the assignment of concepts to variety conditions, sequence of concepts, and assignment of nonsense names was counterbalanced among the independent groups.

For the experimental task, E read a set of sentences (or a passage) which contained an artificial word to replace the concept to be acquired. For example, two sentences for "newspaper" were: Every afternoon my friend, Eddie, comes to deliver the gribble on his bicycle. Sometimes father buys a gribble himself.

After the sentences were read, another set of sentences were read which contained the artificial word. These were generalization test sentences in which the artificial word was sometimes used appropriately and sometimes not. After each test sentence was read, Ss were to record whether its use was appropriate or not. Finally, the S was to report his definition of the artificial word. The procedure was repeated for a second trial on the same concept. The same procedure was then used for the acquisition of the second concept.

In the analysis of the data, the frequency of correct definitions were recorded, the frequency of acceptances of the new word in the generalization sentences regardless of the correctness of their usage, and the frequency of acceptances of the new words in the sentences in which such usage was correct.

Verbal Acquisition Experiment 2. Eight independent groups were involved in this experiment which employed a mixed design in that Ss received half of the concepts to be acquired under a large variety and the other half under a small variety. There were four sets of two independent groups. Four groups received a very small variety consisting of two different instances and four groups received a small variety consisting of three different instances, and all groups received a large variety consisting of six different instances. Two of the groups receiving a very small variety were Kindergarten Ss and the other two groups were 4th and 5th grade Ss. The other four groups were 4th and 5th grade Ss.

The concept acquisition materials were highly similar to those used in experiment 1, but each S was given ten concepts instead of two. Intentional set was used throughout and no generalization test was administered. For the two pairs of groups given very small variety, one member of a pair received one random half of the concepts in the small variety and the other member of the pair received that half of the concepts in the large variety. The Kindergarten pair received the same materials in the same sequence as the older sample. With respect to the other four groups, one pair was assigned to concepts in the same manner, the other pair of groups was given the same materials as the first group, but the sequence of sentences within concepts and the sequence of concepts were assigned a different random sequence. From among those tested, Ss were selected at random within a specified range of mental age.

The number of concepts acquired after the sixth sentence was read were recorded for each S separately for the small and large variety concepts for all groups. For the groups receiving the small variety, the responses after three concepts were recorded.

Perceptual Recall Experiment 1. Four independent groups of Kindergarten Ss and four independent groups of 4th and 5th grade children were employed. Ss were tested in intact classes in which all Ss received the same instructional set but some children received large variety and others received small variety. The entire design involved independent groups. Two levels of variety and set yielded four independent groups. In addition, there were sixteen different types of stimulus booklets and stimulus booklets were confounded with Ss. Ss were selected at random from among those tested, provided that they had been administered the appropriate conditions.

Ss who received the intentional set were instructed to try to notice the features common to a series of eight flags one of which would appear on each of the eight pages of a booklet. Those receiving the incidental set were instructed to make artistic judgments about the flags. Each flag contained 4 geometric forms in 4 different colors which were repeated on each page. There was variation in size and position on the flag. For the small variety, two different instances of flags were presented four times while for the large variety, eight different flags were shown. The exposure time was controlled. All Ss were asked to construct a flag from memory which would show the forms and their locations as they had been in the flags they had seen. After one flag was constructed, the procedure was repeated.

A scoring system was devised which allowed one point for each correct aspect of the constructed flag.

Perceptual Recall Experiment 2. The experimental design for the Kindergarten sample was identical to the preceding design, except that irrelevant variety was used instead of relevant variety. For the older Ss, both relevant and irrelevant variety were employed in an eight independent group design. Irrelevant stimuli were three forms added to each page of each booklet which never recurred on every page of a booklet. If large variety, they would be entirely different on every page of the 8-page booklet; if small variety, two different sets of three would each be repeated eight times. For the Kindergarten groups, the four relevant forms on the flag remained constant on each page. For the older group, the same stimuli as used for experiment 1 were repeated.

The experimental procedures and scoring were identical to those employed in experiment 1.

Results and Discussion: Verbal Acquisition Experiments

Although not significant, there was a strong trend for the large variety to produce more efficient concept formation than the small variety, for the Kindergarten Ss in both verbal acquisition experiments. For the older Ss, including both experiments, it was also true that large variety was more beneficial but it was clearly true only when set was intentional. When set was incidental the large variety was better for a narrow criterion of correctness, but when the broad criterion was used, a greater number of cases in which the small variety was superior occurred under the small variety condition. For the easy concept, there was a trend for more of the older Ss to be more efficient under small variety than under large variety.

The results suggest that for verbal concept acquisition, a large variety of instances is usually more effective than a small variety of instances for both age groups. However, when the concept is very easy, or perhaps when the students are very limited in ability, a small variety is more effective. A small variety also appears to be more effective when a broad criterion of correctness is employed and the set is incidental. These results were obtained for the 4th and 5th grades.

A large variety of instances also promoted generalization of the nonsense word to new contexts in which the usage of the word was grammatically correct. There was a slight trend toward greater generalization under large variety when the meanings of the words in the new context were also adequate.

Results and Discussion: Perceptual Recall Experiments

The effect of variety was found to depend upon whether or not irrelevant stimuli were present. In experiment 1 in which no irrelevant stimuli were present, the 4th and 5th grade Ss recalled more features under the small variety conditions than the large variety conditions. The Kindergarten Ss also recalled better under the small variety conditions when set was intentional, but when set was incidental they tended to recall more under the large variety conditions. For the older Ss, it was found for experiment 2, that the effect of relevant variety was opposite to that described above in that the large variety produced better recall of features. The variety of the irrelevant aspects of the instances tended to relate to recall as follows: Small variety tended to induce better recall of instances than large variety for the older sample, but for the Kindergarten Ss the results were variable.

In general, the experiments did not support the hypotheses concerning the effects of set and variety but they are suggestive of the nature of the processes by which common features are learned and verbal concepts acquired.

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APPENDIX A

APPENDIX A

Project Number 1459

Project Title: Effects of Cognitive Set and the Variety of
Relevant Experience on Concept Formation in
Children.

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Date Submitted: April 11, 1961

Date Revised: March 9, 1962

Duration: May 1, 1962 through June 30, 1963

Outline of Research Project

Title: Effects of Cognitive Set and the Variety of Relevant Experience on Concept Formation in Children.

I. Problem

The notion central to this investigation is that a basic process of thinking is present in children of all ages, and that as they mature and when the cognitive set is relevant, another process becomes available. Further, hypothesized qualitative differences between the two processes will be explored.

The significance of the proposed research lies not merely in the possible direct applicability of the conclusions to classroom method but primarily in the vast applicability of the theoretical view to which the research relates. A developmentally-oriented multi process theory of thinking, if valid, can, if valid, have critical import for the educative process. It provides a framework for understanding intuitive as well as deductive thought, and for describing styles of thinking. Teaching methods and effective programming of teaching machines should reflect the processes demanded by the problem and the processes available to the child. The possibility of adjusting methods of teaching to styles of thinking and even of grouping on this basis, while remote, can be contemplated with reference to a view such as here proposed.

The present view is an attempt to accomplish more than a qualitative description of the problem-solving processes used by children of different ages. In that the theoretical description of thinking at one stage implies the conditions under which new techniques of thought may be acquired, it suggests methods of stimulating the

acquisition of increasingly mature processes of thought. Consequently, it may explain the progression, hitherto mysterious, from one stage of thinking to another.

II. Objectives

An experimental study is designed to shed light on the following hypotheses:

- a. The superiority for concept learning of intentional set over unintentional set should be greater for children about ten years of age than for those about five years of age.
- b. Intentional concept formation should, for older children, be facilitated by exposure to a large variety of examples. For the younger children, however, a small variety should be more beneficial.
- c. Regardless of set, a small variety of examples should be more beneficial than large variety for the younger children; for the older group small variety should only be superior when set is unintentional.

III. Related Research

The proposed experiments extend an earlier study using young adults (Podell, 1958). In that study an unintentional set was used to represent Summation and an intentional set to represent Active Search. A difference in concept formation favoring large variety was obtained under intentional set, while the opposite result, a difference favoring small variety was obtained under unintentional set. In the current study it is hypothesized that this effect should occur only for ten-year-olds who have acquired Active Search. Moreover, it

is hypothesized that if Summation is the only process in the repertory of the very young, small variety should be more effective regardless of their mental set.

- a. Logical thinking in children. Inhelder and Piaget (1958) have described the achievements of children in the logical solution of problems; the present approach, however, attempts to elucidate the processes underlying these achievements. Directly relevant to the present investigation is Piaget's description of intuitive thought in children ages 4 to 7 as it contrasts with the operational thinking of young adolescents. This empirically grounded description of the appearance of deductive reasoning as a final stage of logical thinking lends credence to our hypotheses that Active Search appears only in older children and provides data which the present approach must account for.
- b. The amount of variety of the instances presented for concept learning. Research by Harlow (1951) illustrates the relevance for animals of a wide variety of examples to the breadth of concept attained. It seems reasonable to postulate that animals would form concepts on the basis of the Summation process; consequently, prima facie, his results appear to contradict the prediction that small variety should be superior. However, according to Harlow's Learning Set Theory (1959), the most efficient technique for training monkeys involves repeated trials on one problem until the point where the gain from trial to trial diminishes. Beyond this point,

new problems should be introduced, and even then "between the very early and very late problems, the number of trials per problem would be gradually reduced" (Harlow, 1959). Consequently, consistent with the view posited, small variety is more efficient for animals early in concept learning than large variety. The effect of variety may well depend upon whether one considers concept formation or concept application, intentional or incidental set, and mature or immature thinkers. Morrisett and Hovland (1959) have investigated the effect of varying the number of instances on human concept formation and application. Their results show that although acquisition of a response is better under single problem learning, immediate transfer is clearly better for a medium variety of instances (3), and a very large variety (24) is least efficient for acquisition and transfer. They have not, however, considered age and set, the variables under investigation.

IV. Procedure

The experimental plan (see Table I) is an independent group design in which the major experimental variables are intentionality of set and variety of instances.

Table I
Experimental Paradigm

	Set		
		Intentional	Unintentional
Variety	Small		
	Large		

By repeating the paradigm for two age levels, eight independent groups are planned which are to contain about ten Ss from each of two classes, approximately 160 Ss being desired in all.

It is estimated that half of the children are to be five to six years of age, in kindergarten; the other half nine to ten years of age, in the fourth grade. The classes are to be obtained from the schools of the Bay Area.

Group testing may be administered and, to the extent possible, Ss will be randomly selected from the same IQ range, and equally from each sex. If two tasks are given to every S, task A will be given first in one class and task B first in the other class within each treatment group. This confounds the variance due to class with that of sequence.

Appropriate analyses of the data, such as analysis of variance, will be performed separately for each task. If the analysis of variance is performed, the treatments would be intentionality of Set, Variety of examples and Class-sequence while the level differs with respect to Age of S. The two analyses are thought to permit separate but not independent tests of the same hypotheses.

One experimental task involves the successive presentation of geometric designs similar to those used earlier (Podell, 1958). These designs, called Zaregs, have certain similarities, but vary in irrelevant respects. From these examples, Ss are to form the concept of Zareg, defined as the elements common to all of the designs. Various tests of concept attainment will be used including one which will consist of the assembly on a flannel board or other suitable

material of various presented parts into a "whole Zareg." Extra parts will be available. A second task will involve the learning of verbal concepts.

Examples of the concepts to be learned are to be presented by means of a 35 mm slide projector that permits successive presentation of the examples controlled both for exposure time and for the interval between exposures. A large variety of examples is operationally defined as approximately twelve examples of the same concept, while a small variety consists of only two different examples. Approximately the same amount of exposure or demonstration time will be given under the two conditions, for example, by presenting each example in the large variety condition twice and presenting each one under small variety condition about twelve times.

The intentional set will be instigated by instructions, such as "try to figure out the rule" or "find out what there is about every one of these designs that makes it like every other one." Unintentional set, for example, may be accompanied by the suggestion that they should try to notice which designs are prettier. Similar amount of practice in carrying out the relevant set will be given.

V. Personnel

One Principal Investigator is Harold D. Carter, Professor of Education, University of California, Berkeley, California. He will assume administrative responsibility for the execution of the research and will supervise the writing of reports.

He received his Ph.D. degree at the University of Minnesota in 1930, with a major in Psychology, and a minor in mathematics and biometry.

Under the sponsorship of Lewis M. Terman, he spent the years 1930-1932 at Stanford University as Social Science Research Council Fellow.

In the following five years he was a member of the Adolescence Study staff at the University of California Institute of Child Welfare. In 1934 he taught advanced statistics in Psychology and Education at Stanford University, and was a research associate from 1935 until 1937 when he entered the Education Department at the University of California. He is the author of about fifty publications, including contributions to the major yearbooks, encyclopedias, and technical journals in psychology and education.

The other Principal Investigator is Harriett Podell, Lecturer in Educational Psychology, Department of Education, University of California, Berkeley, California. She will actively supervise the collection and processing of data and will prepare reports under the guidance of the Director, Dr. Carter.

Having received her A.B. from Bryn Mawr College in 1950, and an M.A. from Clark University in 1954, she received her Ph.D. in Psychology in 1957 at Clark University. Her dissertation, entitled Two Processes of Concept Formation, appears as a Psychological Monograph.

In 1952-1953 she was Research Associate at Tufts University. At Clark she was successively Scholar, Fellow, Research Assistant, and finally, at the post-doctoral level, Research Associate. The problem areas ranged from a study of the development of language to a study of the effect of emotion on two processes of thinking. Continuing the latter research, in 1958-1959, she became Junior Research Psychologist in the Psychology Department at the University of California. In 1959

she was Research Psychologist at the Institute of Personality Assessment and Research at the University of California at Berkeley and engaged in research concerning creative thinking as affected by variety in the stimulating conditions. After teaching at Mills College as Visiting Assistant Professor, she entered the Education Department at the University of California.

VI. Abstract

Objectives. The proposed experimental investigation of children's thinking is framed within a theory that concept formation proceeds by two processes, Summation and Active Search (hypothesis testing). While Summation is thought to occur in children of all ages, Active Search is thought to become available later whenever the cognitive set is appropriate. Although Active Search should improve the efficiency of concept formation, this effect should depend upon the environmental conditions. Based on theory, it is hypothesized that if, unlike five-year-olds, children ten years of age use Active Search when deliberately forming concepts, their concept formation under intentional set should be superior to unintentional concept formation. For five-year-olds any difference in the effect of set should be smaller. Based on theory which is supported empirically, it is hypothesized that a large variety in the instances should facilitate the formation of a concept among the older Ss when they are intentionally set, but small variety might be better for younger ones regardless of set.

This study should promote understanding of diverse processes in children's cognition which underlie both logical and intuitive thought.

Procedure. One laboratory task and one curriculum-relevant task of concept formation are to be employed in the study of five- and ten-year-old children. An independent group design is proposed in which classes within an age level are randomly assigned to one of four treatments. Large and small variety and intentional and incidental set in combination yield four treatments. Intentional concept formation in which the children try to form a concept is to be compared with unintentional concept formation which occurs under an irrelevant set. Further, the acquisition of concepts based on large and small variety of examples is to be studied in children of each age.

B-1

APPENDIX B

Stimulus Materials, Verbal Acquisition Experiment 1

(Large Variety) Newspaper

Every afternoon my friend Eddie, delivers the gribble (bordick) on his bicycle. Sometimes Father buys a gribble (bordick) himself. Father likes to look at the gribble (bordick) when he comes home in the evening. Then he gives the gribble (bordick) to Tom for the Cub Scouts. Mother uses a gribble (bordick) to wrap things. In winter Father crumples the gribble (bordick) to light a fire.

(Large Variety) Train

Mary and John went to see the gribble (bordick). Every gribble (bordick) was very large. John told Mary that the gribble (bordick) had travelled for many days across the land. The gribble (bordick) made a lot of noise. One gribble (bordick) was carrying food and coal from many different places. Mary wanted to ride on a gribble (bordick).

(Small Variety) Newspaper

Every afternoon my friend, Eddie, comes to deliver the gribble (bordick). Eddie delivers the gribble (bordick) on his bicycle. Father looks at the gribble (bordick) when he comes home. Father likes to look at the gribble (bordick) in the evening. It is nice for Eddie to deliver the gribble (bordick) to our home. When Father comes home, he can look at the gribble (bordick).

(Small Variety) Train

John told Mary that the bordick (gribble) had travelled for many days. The bordick (gribble) had travelled across the land. One bordick (gribble) was carrying food from different places. One bordick (gribble) was carrying coal. That bordick (gribble) was carrying food and coal from different places. The bordick (gribble) had travelled for many days across the land.

(Large Variety) Gather

1. Jimmy liked to lidber (hudray) stamps from all countries.
2. When there is an accident, people often lidber (hudray) on the corner to see.
3. The children tried to lidber (hudray) around Johnny after he won the game.
4. The girls went to the park to lidber (hudray) flowers.
5. At an Easter Party, the children often have baskets to lidber (hudray) the eggs.
6. When there is a fire, the police will not let the people lidber (hudray) on the street.

(Small Variety) Increase

1. When there is an accident, people often hudray (lidber) on the corner to see.
2. The girls went to the park to hudray (lidber) flowers.
3. The girls went to the park to hudray (lidber) flowers.
4. When there is an accident, people often hudray (lidber) on the corner to see.
5. When there is an accident, people often hudray (lidber) on the corner to see.
6. The girls went to the park to hudray (lidber) flowers.

(Large Variety) Increase

1. If you eat well and sleep well, you will lidber (hudray).
2. You lidber (hudray) what you know by reading and studying.
3. You should leave room on the shelf in order to lidber (hudray) the books.
4. You must lidber (hudray) the chairs if more children come to the class.
5. Mrs. Smith had to lidber (hudray) the shoes so they would fit Jimmy.
6. A balloon will lidber (hudray) if you put air into it.

(Small Variety) Gather

1. You must hudray (lidber) the chairs if more children come to the class.
2. A balloon will hudray (lidber) if you put air into it.
3. A balloon will hudray (lidber) if you put air into it.
4. You must hudray (lidber) the chairs if more children come to the class.
5. You must hudray (lidber) the chairs if more children come to the class.
6. A balloon will hudray (lidber) if you put air into it.

Preliminary Instructions, Fourth grade, Verbal Acquisition

Experiment 1

Write your name, your age and your teacher's name. Don't open booklets yet. Now I am going to read you some sentences which are either silly or OK.

(Don't open your booklet yet.) Try not to make a sound; don't laugh or sigh, just write what I ask you. At the bottom of the cover page, number 1 to 5. I will read sentence 1, then you write "silly" or "OK".

Silly or OK

1. Jerry has two heads.
2. Johnny ate the car for breakfast.
3. Daddy drove the car to work.
4. Mark likes to grow books.
5. John likes to grow vegetables.

If you don't know what the words mean or the sentence means leave a blank. If you really don't know whether the sentence is silly or not leave a blank.

Preliminary Instructions, Kindergarten, Verbal Acquisition

Experiment 1

(Do not read parenthesized items.) (Be sure the names are on the booklets and the teacher's name.)

Put your marker under the first row of pictures. Do you see pictures of 2 girls?

One is silly. One is OK. Put a line through the silly one. Now I am going to read you some sentences which are either silly or OK. If I read a sentence and it is silly, put a mark on the silly face. If I read a sentence and it is OK, put a mark on the nice face. Move your marker down to the next row of pictures (number two).

2. Jerry has two heads. Is that silly or is it OK? (Be sure they all marked the silly face.)

Move your marker down (do this each time).

3. Johnny ate the car for breakfast.
4. Daddy drove the car to work. (from now on) Try not to laugh or make any noise.
5. Mark likes to grow books.
6. John likes to put the door.
7. Mary filled the container with liquid. (Be sure to ask about this one.)

If you don't know whether it's silly or not, don't mark either face, but move your marker down to the next one.

Instructions, Verbal Acquisition Experiment 1

All Groups

Write your name, your age and your teacher's name. Don't open booklet yet. Now I am going to read you some sentences which are either silly or OK. (Don't open your booklet yet.) Try not to make a sound; don't laugh or sigh, just write what I ask you. I will read sentence 1, then you will write silly or OK at the bottom of the cover page, numbers 1-5.

Silly or OK

1. Jerry has two heads.
2. Johnny ate the car for breakfast.
3. Daddy drove the car to work.
4. Mark likes to grow books.
5. John likes to grow vegetables.

If you don't know what the word means, or what a sentence means, leave a blank. If you really don't know if the sentence is silly or not leave a blank.

Instructions for Incidental Set

I am going to read a story that has a new word in it. As I read the story, try to get the meaning of the whole story without worrying about what that particular word means. Later I will read you sentences which have the new word in them. But now I want you to listen to the story and try to understand what it means without paying any special attention to the new word.

Be absolutely quiet while I am reading the story. Don't say a word while I am reading the story or the sentences later. You musn't laugh if it sounds funny or make sounds of any kind. Can you do that?

Be ready to turn the page.

Instructions for Intentional Set

I am going to read a story that has a new word in it. As I read the story, try to figure out what the word means. Later I will read you sentences which have the new word in them. Let's see whether you can figure out the meaning of the new word.

Be absolutely quiet while I am reading the story. Don't say a word while I am reading the story or the sentences later. You musn't laugh if it sounds funny or make sounds of any kind. Can you do that?

Be ready to turn the page.

Sample Answer Sheet, Generalization Test
Kindergarten, Verbal Acquisition Experiment 1

Experimental Design and Experimental Treatments

Experiment 1 Verbal Acquisition

A 4th	B 4-5	C 4th	D 4-5
<u>Incidental</u>	<u>Intentional</u>	<u>Incidental</u>	<u>Intentional</u>
3. Increase - Small hudray 4. Gather - Large lidber	3. Gather - Small hudray 4. Increase - Large lidber	3. Increase - Large hudray 4. Gather - Small lidber	3. Gather - Large hudray 4. Increase - Small lidber
<u>Intentional</u>	<u>Intentional</u>	<u>Intentional</u>	<u>Intentional</u>
1. Newspaper - Large gribble 2. Train - Small bordick	1. Train - Large gribble 2. Newspaper - Small bordick	1. Newspaper - Small gribble 2. Train - Large bordick	1. Train - Small gribble 2. Newspaper - Large bordick
E 4	F 5	G 4	H 5
<u>Intentional</u>	<u>Incidental</u>	<u>Incidental</u>	<u>Intentional</u>
3. Increase - Small hudray 4. Gather - Large lidber	3. Gather - Small hudray 4. Increase - Large lidber	3. Increase - Large hudray 4. Gather - Small lidber	3. Gather - Large hudray 4. Increase - Small lidber
<u>Incidental</u>	<u>Incidental</u>	<u>Incidental</u>	<u>Incidental</u>
1. Newspaper - Large gribble 2. Train - Small bordick	1. Train - Large gribble 2. Newspaper - Small bordick	1. Newspaper - Small gribble 2. Train - Large bordick	1. Train - Small gribble 2. Newspaper - Large bordick

Scoring Criteria: Verbal Acquisition Experiment 1

Concept: Gather

Narrow Criterion

Wholly Correctcollect
gatherPartially Correctbunch up
get

Broad Criterion

One-half Correct

Small

move
get
go around
hang around
crowd around
walk around
look at
watch
stand
pick
go up
bring
put more things in it

Large

move
get
go around
hang around
crowd around
walk around
look at
watchConcept: Increaseincrease
(more or bigger)
as unit
enlargelengthen, widen
stretch
add to
make more
get bigger
make larger
expand
to get more
larger
want moreopen
blow up
puff out
move (around)
float
rise
fix
grow
movemake space
arrange
pop
separate
go up
pop
float
puff outopen

move (around)

fix

move
keep
make spaceseparate
adjust
keep
save
to store

Experimental Treatments and M.A. Range & Mean by Subgroups
Kindergarten Sample, Verbal Acquisition Experiment 1

Newspaper - Train

A		B		C		D	
Intentional		Intentional		Intentional		Intentional	
1. Newspaper - Large	gribble	1. Train - Large	gribble	1. Newspaper - Small	gribble	1. Train - Small	gribble
2. Train - Small	bordick	2. Newspaper - Small	bordick	2. Train - Large	bordick	2. Newspaper - Large	bordick
Range 5'6" - 5'9"	Mean 5'6"	Range 5'7" - 7'3"	Mean 6'2"	Range 5'6" - 6'5"	Mean 6'1"	Range 4'10" - 7'0"	Mean 6'2"
E		F		G		H	
Incidental		Incidental		Incidental		Incidental	
1. Newspaper - Large	gribble	1. Train - Large	gribble	1. Newspaper - Small	gribble	1. Train - Small	gribble
2. Train - Small	bordick	2. Newspaper - Small	bordick	2. Train - Large	bordick	2. Newspaper - Large	bordick
Range 5'11" - 6'11"	Mean 6'2"	Range 5'6" - 5'11"	Mean 5'9"	Range 5'4" - 6'5"	Mean 5'9"	Range 5'11" - 6'5"	Mean 6'3"

Experimental Treatments and M.A. Range & Mean by Subgroups
4th and 5th Grade Sample, Verbal Acquisition Experiment 1

Easy Concept

Newspaper - Train

AA
4

Intentional
1. Newspaper - Large
gribble

2. Train - Small
bordick

Range 9'7" - 10'4"
Mean 10'

BB
4-5

Intentional
1. Train - Large
gribble

2. Newspaper - Small
bordick

Range 9'2" - 12'7"
Mean 10'8"

CC
4

Intentional
1. Newspaper - Small
gribble

2. Train - Large
bordick

Range 9'1" - 10'5"
Mean 9'11"

DD
4-5

Intentional
1. Train - Small
gribble

2. Newspaper - Large
bordick

Range 9'8" - 13'8"
Mean 11'8"

EE
4

Incidental
1. Newspaper - Large
gribble

2. Train - Small
bordick

Range 8'7" - 10'1"
Mean 9'7"

FF
5

Incidental
1. Train - Large
gribble

2. Newspaper - Small
bordick

Range 10'5" - 11'9"
Mean 10'11"

GG
4-5

Incidental
1. Newspaper - Small
gribble

2. Train - Large
bordick

Range 9'10" - 12'2"
Mean 10'9"

HH
5

Incidental
1. Train - Small
gribble

2. Newspaper - Large
bordick

Range 10'2" - 11'4"
Mean 10'10"

Experimental Conditions, M.A. Range & Mean by Subgroups

Difficult Concept, Verbal Acquisition Experiment ¹₁

AAA	BBB	CCC	DDD
<u>Intentional</u>	<u>Intentional</u>	<u>Intentional</u>	<u>Intentional</u>
Newspaper - Large	Train - Large	Newspaper - Small	Train - Small
Train - Small	Newspaper - Small	Train - Large	Newspaper - Large
Increase - Small	Gather - Small	Increase - Large	Gather - Large
<u>hudray</u>	<u>hudray</u>	<u>hudray</u>	<u>hudray</u>
Gather - Large	Increase - Large	Gather - Small	Increase - Small
<u>lidber</u>	<u>lidber</u>	<u>lidber</u>	<u>lidber</u>
Range 9'11" - 12'2"	Range 10'1" - 13'8"	Range 10'2" - 13'8"	Range 10'2" - 11'4"
Mean 11'2"	Mean 11'7"	Mean 11'11"	Mean 10'10"
EEE	FFF	GGG	HHH
<u>Incidental</u>	<u>Incidental</u>	<u>Incidental</u>	<u>Incidental</u>
Newspaper - Large	Train - Large	Train - Large	Newspaper - Large
Train - Small	Newspaper - Small	Newspaper - Small	Train - Small
Increase - Small	Gather - Small	Increase - Large	Gather - Large
<u>hudray</u>	<u>hudray</u>	<u>hudray</u>	<u>hudray</u>
Gather - Large	Increase - Large	Gather - Small	Increase - Small
<u>lidber</u>	<u>lidber</u>	<u>lidber</u>	<u>lidber</u>
Range 10'7" - 13'8"	Range 10'5" - 11'9"	Range 9'9" - 13'6"	Range 10'6" - 13'8"
Mean 12'2"	Mean 10'11"	Mean 11'2"	Mean 11'6"

¹Newspaper and train preceded gather and increase, but were not scored for this sample.

APPENDIX C

Materials for Verbal Acquisition Experiment 2

2. Finish, complete

1. You should try to pilster the things you have left half done.
2. Mary cannot pilster the problem because she doesn't understand it.
3. If his homework is hard, John doesn't pilster it.
4. Phillip asked Joan to help him pilster his homework.
5. You must have patience to pilster a job.
6. The painter could not pilster the room because his brush broke.

3. Light

1. It is decket longer in summer than in winter.
2. Large windows make a house decket.
3. Mother likes John to be home when it's still decket.
4. The front yard was dark, but the porch was decket.
5. It should be decket for reading.
6. The TV is decket.

4. Soft

1. When it got warm, the candle became bocker.
2. If you don't want it to be heard, your whisper should be bocker.
3. Uncle Ed likes a bocker chair after dinner.
4. Baby clothes are usually made in bocker colors.
5. A fur coat is bocker and warm.
6. Many people leave a bocker light in the bathroom all night.

5. Dream

1. After seeing the ghost movie, Sue hated to go to bed for fear of what she will lagger.
2. When Billy used to lagger he didn't know whether it was real or not.
3. When dogs move strangely in their sleep, we wonder if they can lagger.
4. Jimmy wants a new bicycle so badly that he will probably lagger of one.
5. When George doesn't know the right answer, he may sometimes lagger one up.
6. Many people can't remember what happens when they lagger.

6. Obstacle

1. Jane had to turn back because there was a corplum in the path.
2. The way is clear if there is no corplum present.
3. A lazy man stops working as soon as there is a corplum.
4. A corplum keeps you from doing what you want to do.
5. Some people don't want to start a job if they know there is a corplum.
6. He had to get rid of the corplum before finishing the task.

7. Stick or piece of wood

1. A long surta may be made shorter.
2. A wet surta does not burn.
3. You can make a surta smooth.
4. The painter used a surta to mix his paints.
5. Many things may be made out of a surta.
6. You can use a surta for many things.

8. Happiness

1. Some people think about the things that bring them tortum.
2. After trouble tortum usually returns.
3. The woman remembered the tortum she had as a girl.
4. The people at the circus usually seem full of tortum.
5. Comfort at home and a good job were all that Uncle Ben needed for tortum.
6. Tortum and good health are found together.

9. Stones

1. Billy collected different kinds of garids.
2. Some garids are found under water.
3. Garids often make a road very rough.
4. Only bad boys throw garids.
5. A farmer does not like to find garids in his fields.
6. Garids can be polished to look smooth and shiny.

10. Hole

1. John fell into a rikess in the road.
2. Something with many tiny rikess is used in the kitchen.
3. Some rikess have a bottom.
4. You can usually put things into any rikess.
5. The more you take out of a rikess, the larger it gets.
6. A bottle has only one rikess.

11. Courage

1. If you have narish you will not cry when you get hurt.
2. You need narish to fight with a boy bigger than you.
3. If you do something bad and then tell the truth, you have narish.
4. We all admire someone who has much narish.
5. A person who saves a baby from drowning in deep water has much narish.
6. You need narish when you start to do a hard job.

12. Faults, defects

1. If a suit has many elsons it is sold very cheaply.
2. A person who has many elsons usually has few friends.
3. People with elsons are often unhappy.
4. Some elsons can be fixed.
5. Some things are useful even if they have many elsons.
6. People usually talk about the elsons of others, but not about their own.

Concepts and Sentences Used for Each of the Subgroups
Showing the Sequence of Presentation of Sentences within Concepts

Verbal Acquisition Experiment 2

Concept	Sentence Number	A	B	Subgroup		E	F
				C	D		
² Finish	1	5		1	1	1	3
	2	4	2		2		1
	3	2		2	3	3	5
	4	3	1		4		4
	5	1		3	5	2	6
	6	6			6		2
³ Light	1		5	1		6	1
	2		6	2	1	3	3
	3	2	4	3		5	
	4		2	4	2	2	
	5		1	5		4	
	6	1	3	6	3	1	2
⁴ Soft	1		4		1		4
	2		3	1	2	1	1
	3	2	5	2	3	3	5
	4		1	3	4	2	6
	5	1	2		5		3
	6		6		6		2
⁵ Dream	1	4	1	1		5	
	2	1		2	1	4	3
	3	5		3	2	2	2
	4	6		4	3	3	1
	5	3	2	5		6	
	6	2		6		1	

Concept	Sentence Number	Subgroup					
		A	B	C	D	E	F
⁶ Obstacle	1	4	2		1		3
	2	2		3	2	1	5
	3	6		2	3	3	2
	4	5		1	4	2	4
	5	1	1		5		1
	6	3			6		6
⁷ Stick	1		4	1	1	2	3
	2		5	6	2	1	1
	3	1	6	5	3	3	2
	4		1	3		6	
	5	2	2	4		4	
	6		3	2		5	
⁸ Happiness	1		3	3	1	2	4
	2	1	1	1	2	3	5
	3		5	2	3	1	6
	4		4		4		1
	5	2	6		5		2
	6		2		6		3
⁹ Stones	1	3	2	1		1	
	2	5		2	1	4	2
	3	2	1	3		6	
	4	4		4	2	3	1
	5	1		5	3	5	3
	6	6		6		2	

Concept	Sentence Number	A	B	Subgroup		E	F
				C	D		
¹⁰ Hole	1	2	3	1	1	3	2
	2		4	2	2	1	5
	3		5	3	3	2	3
	4		6		4		1
	5		1		5		6
	6	1	2		6		4
¹¹ Courage	1		4	1	1	3	2
	2	1	3	2	2	1	1
	3	2	1	3	3	4	3
	4		5	4		6	
	5		2	5		5	
	6		6	6		2	
¹² Fault	1	4	2		1		6
	2	2		1	2	2	2
	3	1		2	3	1	1
	4	5		3	4	3	3
	5	6			5		5
	6	3	1		6		4

Experimental Conditions, M.A. Range & Mean by Subgroups

Difficult Concept, Verbal Acquisition Experiment 2¹

AAA	BBB	CCC	DDD
Intentional	Intentional	Intentional	Intentional
Newspaper - Large	Train - Large	Newspaper - Small	Train - Small
Train - Small	Newspaper - Small	Train - Large	Newspaper - Large
Increase - Small	Gather - Small	Increase - Large	Gather - Large
<u>hudray</u>	<u>hudray</u>	<u>hudray</u>	<u>hudray</u>
Gather - Large	Increase - Large	Gather - Small	Increase - Small
<u>lidber</u>	<u>lidber</u>	<u>lidber</u>	<u>lidber</u>
Range 9'11" - 12'2"	Range 10'1" - 13'8"	Range 10'2" - 13'8"	Range 10'2" - 11'4"
Mean 11'2"	Mean 11'7"	Mean 11'11"	Mean 10'10"

EEE	FFF	GGG	HHH
Incidental	Incidental	Incidental	Incidental
Newspaper - Large	Train - Large	Train - Large	Newspaper - Large
Train - Small	Newspaper - Small	Newspaper - Small	Train - Small
Increase - Small	Gather - Small	Increase - Large	Gather - Large
<u>hudray</u>	<u>hudray</u>	<u>hudray</u>	<u>hudray</u>
Gather - Large	Increase - Large	Gather - Small	Increase - Small
<u>lidber</u>	<u>lidber</u>	<u>lidber</u>	<u>lidber</u>
Range 10'7" - 13'8"	Range 10'5" - 11'9"	Range 9'9" - 13'6"	Range 10'6" - 13'8"
Mean 12'2"	Mean 10'11"	Mean 11'2"	Mean 11'6"

¹ Newspaper and train preceded gather and increase, but were not scored for this sample.

Sample Problem

Verbal Acquisition Experiment 2

1. Our teacher is very much like an indar.
2. The puppies cried out when their indar left them.
3. Aunt Sarah is going to be an indar next summer.
4. A big sister is like an indar.
5. An indar helps you when you are in trouble.
6. Indar said you must wear your coat.

D-1

APPENDIX D

Assignment of Colors, Forms, Positions, and Background
to Booklets: Perceptual Recall Experiment 1

Background	Position				
1Q	A	R ₁	B ₂	G ₃	Y ₄
2	B	B ₁	G ₂	Y ₃	R ₄
2	C	Y ₁	R ₂	B ₃	G ₄
1	D	G ₁	Y ₂	R ₃	B ₄
1R	A	B ₃	R ₄	Y ₁	G ₂
1	B	Y ₃	G ₄	B ₁	R ₂
2	C	G ₃	Y ₄	R ₁	B ₂
2	D	R ₃	B ₄	G ₁	Y ₂
1S	A	G ₄	Y ₃	R ₂	B ₁
1	B	B ₄	R ₃	Y ₂	G ₁
2	C	Y ₄	G ₃	B ₂	R ₁
2	D	R ₄	B ₃	G ₂	Y ₁
2T	A	Y ₂	G ₁	B ₄	R ₃
1	B	G ₂	Y ₁	R ₄	B ₃
1	C	R ₂	B ₁	G ₄	Y ₃
2	D	B ₂	R ₁	Y ₄	G ₃

R, red; B, Blue; G, green; Y, yellow.

Sample Stimulus: Perceptual Recall Experiment 1

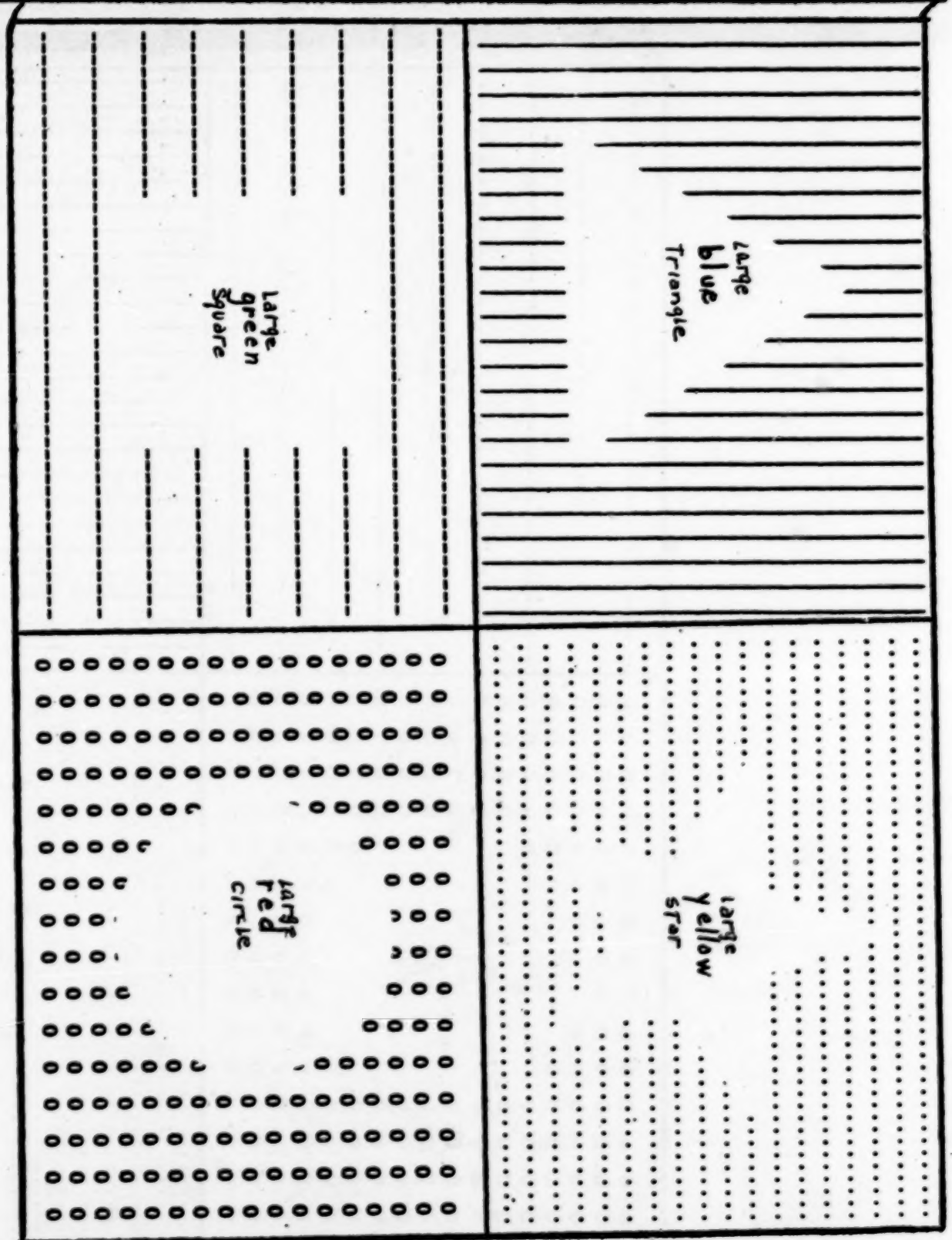
Kindergarten and 4th and 5th Grade

Small Variety, Instance 1

Small green square	Small yellow star
Large red circle	Large blue triangle

Perceptual Recall Experiment 1

Instance 2



Instructions for Perceptual Recall Experiment 1

INTENTIONAL

In this test booklet, you will see pictures of a certain type of flag. All the flags of this type have certain features in common. In other words, they are alike in some ways though not in others. Try to find out how they are alike; try to notice the things which are in all the flags you see and which you would guess are in all flags of this type. Try not to look at your neighbor's booklet. You are not to be allowed to look back. This is important. When I say turn, then you turn to the next page but do not turn back or ahead. I am timing each page so it is important that you turn right away when I say "turn". Remember: try to notice all the ways in which they are alike. Any questions? There is a blank white page after the cover page. Then comes page 1, the first flag. When I say turn, turn to the white page. I will then say, right away, turn to page 1. Turn again. There will be a 1 at the bottom of the first flag. Look at it until I say, turn to page 2. Ready!

INCIDENTAL

In this booklet, you will see pictures of a certain type of flag. Though they are alike in some ways, try to notice how well you like each one and how well you like this type of flag generally. For each flag, decide whether you like it very very much, very much, medium, or don't like it. Try not to look at your neighbor's booklet. This is very important. They are all pretty much the same but I am trying to study your own impressions based just on what you see in your booklet. You will not be allowed to look back. When I say turn, then you must turn to the next page but do not look back or ahead. I am timing each page, so it is important that you turn right away when I say turn. Remember: try to decide whether you like the flag very very much, very much, medium, or don't like it. Any questions?

There is a blank white page after the cover page. Then comes page 1, the first flag. When I say turn, turn to the white page. I will then say right away, turn to page 1. Then turn again. There will be a 1 at the bottom of the first flag. Look at it until I say, turn to page 2, and so forth. Ready?

Flag Test Scoring Categories,¹ Perceptual Recall Experiment 1

- | | 1 | 2 | 3 | 4 |
|--|---|---|---|---|
| a. Shapes on the flag (The number of shapes at each complexity level which are on the flag.) | | | | |
| b. Colors on the flag (The number of "seen" colors on the flag at each complexity level.) | | | | |
| c. Color of the shapes (anywhere) on the flag: (A check for each complexity level for which the shape appears on the flag and is colored correctly. If more than one, i.e., two, shapes of a kind appear, two checks are given if both are colored correctly.) | | | | |
| d. Color of the shape in the envelope. A check is entered if the shape is colored correctly; two checks if both are colored correctly and both are in the envelope. | | | | |
| e. Shapes on the background. Enter a check under the complexity level corresponding to the shape if it is on the correct background. | | | | |
| f. Shape in the correct position (the number of shapes in the correct position). | | | | |
| g. Color on the correct background (the number of colors on the correct background). | | | | |
| h. Color in the correct position (the number of colors in the correct position). | | | | |

¹A check is counted as one point.

Mean M.A. and Range by Subgroups
 Perceptual Recall Experiment 1

		Intentional Set		Incidental Set	
		Small Variety	Large Variety	Small Variety	Large Variety
Kindergarten	Range	5'2"-7'4"	5'4"-7'6"	5'1"-7'9"	4'10"-7'7"
	Mean	6'3"	6'4"	6'2"	6'5"
4th and 5th Grade	Range	10'4"-14'10"	9'10"-13'6"	9'5"-13'5"	9'2"-14'4"
	Mean	12'3"	12'3"	11'8"	11'9"
4th and 5th Grade	Range	9'10"-14'10"	9'8"-14'9"	9'5"-13'10"	9'1"-14'4"
	Mean	12'4"	12'2"	11'9"	11'8"

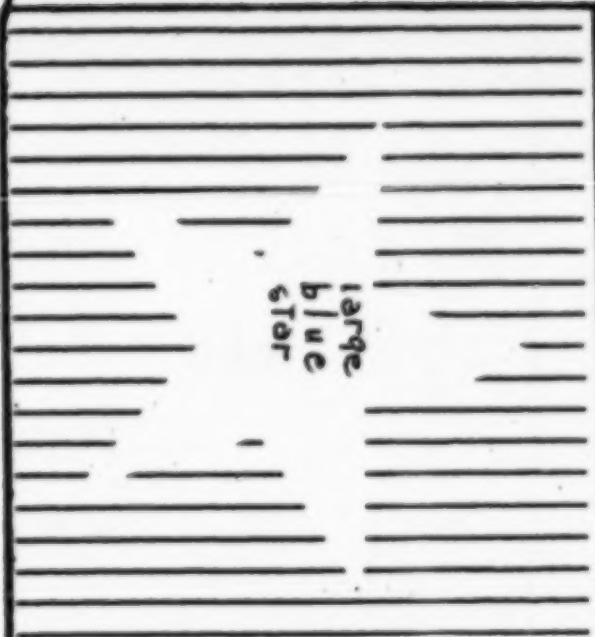
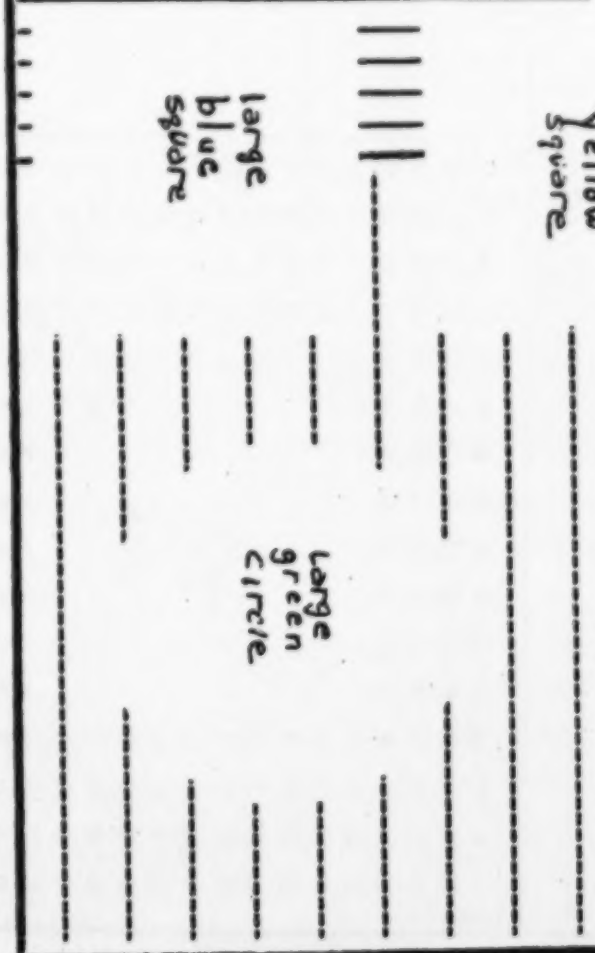
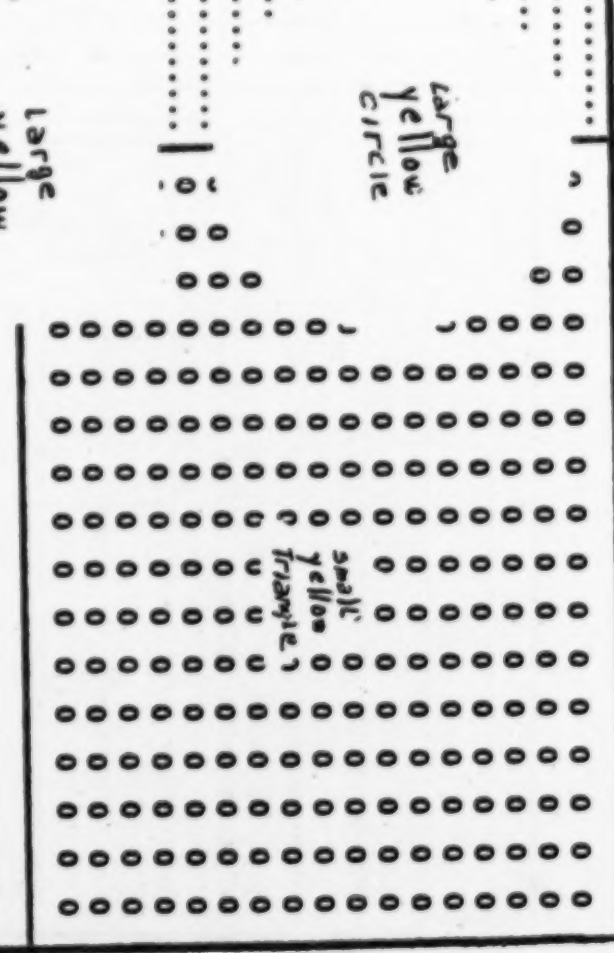
E-1

APPENDIX E

Sample Stimulus: Perceptual Recall Experiment 2;
Kindergarten, Irrelevant Variety: Small, Instance 1

[illegible]

Perceptual Recall Experiment 2, Kindergarten, Instance 2

 large blue star	 large red square
 large blue square	 large yellow square large green circle small yellow triangle

Sample Stimulus: Perceptual Recall Experiment 2; 4th and 5th Grade

Small Variety Relevant, Small Variety Irrelevant, Instance 1

Large yellow circle	Small red triangle Small blue triangle Small green triangle
Large red star Small red square	Large blue square

Perceptual Recall Experiment 2, 4th and 5th Grades,

Instance 2

[illegible]

Mean M.A. and Range by Subgroups

Perceptual Recall Experiment 2

Intentional Set

Incidental Set

Small Irrelevants

Large Irrelevants

Small Irrelevants

Large Irrelevants

Kindergarten:

Range

5'5"-7'2"

5'6"-7'1"

5'5"-7'4"

5'5"-7'3"

Mean

6'4"

6'5"

6'3"

6'3"

Small Irrelevants

Large Irrelevants

Small Irrelevants

Large Irrelevants

Small Variety

Large Variety

Small Variety

Large Variety

Small Variety

Large Variety

Small Variety

Large Variety

9-14

4th-5th Grade:

Range

9'0"-14'6" 9'5"-13'10"

10'3"-15'3" 10'4"-12'7"

9'10"-13'6" 10'4"-15'7"

10'4"-14'6" 9'9"-13'0"

Mean

12'0"

11'11"

12'5"

11'6"

11'8"

12'6"

11'7"

10'9"